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A PRIMER FOR INTERNATIONAL RELIABILITY AND MAINTAINABILITY STANDARDS

Illinois Institute of Technology Research Institute

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13. ABSTRACT *(Maximum 200 words)*
Brief summaries of United States and other world-wide commercial and government reliability, maintainability, availability, and dependability (R/M/A/D) standards are included. Defense Acquisition Reform will result in an increased reliance on other than US military standardization documents. This Primer is useful to reliability and maintainability (R&M) practitioners to help determine what standardization documents (other than US military) are available. Standardization documents were reviewed and summarized from many organizations including the: American National Standards Institute (ANSI), British Ministry of Defense (MOD), British Standards Institute (BSI), Canadian Standards Association (CSA), Institute of Electrical and Electronics Engineers (IEEE), Institute of Environmental Sciences (IES), Electronic Industries Association (EIA), Institute for Interconnecting and Packaging Electronic Circuits (IPC), International Electrotechnical Commission (IEC), International Organization for Standardization (ISO), National Aeronautics and Space Administration (NASA), North Atlantic Treaty Organization (NATO), and the Society of Automotive Engineers (SAE). Eighty-eight summaries were written for those R/M/A/D documents that were found to be system or subsystem oriented, available in English, and not industry or technology specific. The document descriptions include ordering and pricing information. Appendix C contains a listing of hundreds of other R/M/A/D standards. Appendix D is a listing of R/M/A/D standards specific to the telecommunications industry.

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We are thankful for the cooperation of professional societies, industrial associations, and other standards development bodies during the preparation of this Primer. Portions of documents were reprinted with their permission and appear here. Specifically, thanks goes out to the American National Standards Institute (ANSI), the British Ministry of Defense (MOD), the British Standards Institution (BSI), the Canadian Standards Association (CSA), the Institute of Electrical and Electronics Engineers (IEEE), the Institute of Environmental Sciences, Electronic Industries Association/Joint Electron Device Engineering Council (EIA/JEDEC), the Institute for Interconnecting and Packaging Electronic Circuits (IPC), the International Electrotechnical Commission (IEC), the International Organization for Standardization (ISO), the National Aeronautics and Space Administration (NASA), the North Atlantic Treaty Organization (NATO), the Robotics Industries Association (RIA) and the Society of Automotive Engineers (SAE).

A special note of thanks is extended to the Partnership in Reliability, Maintainability, and Supportability Standards and its chairman, Dr. Russ Vacante of the Army Staff Management College. Rome Lab would like to acknowledge Dr. Vacante and the RMS Partnership for initiating and supporting the concept of the Primer and making timely and valuable review contributions that helped make its publication possible.

A special note of thanks is also extended to Rosemary Maginiss of ANSI, who was instrumental in obtaining an agreement with IEC/ISO to publish information from IEC/ISO documents in this report.

EXECUTIVE SUMMARY

Purpose

Defense Acquisition Reform is having a major impact upon the use of military documents for procurement purposes. A primary goal of defense acquisition reform is to replace "How to" requirements with "Performance-based" requirements. When "Performance-based" requirements are not practicable, the use of non-government documents is now preferred as the basis for procurement specification rather than military specifications and standards. This has created a need to know what non-government documents are available, or are being developed to deal with the Reliability, Maintainability, and Availability (collectively known as "Dependability" in many industries) procurement requirements. This document addresses that need.

Report Content

Identified within this report, are currently available non-US military, international and commercial standards that can potentially replace those military specifications and standards historically used to specify Reliability, Maintainability, Availability and Dependability (R, M, A & D) requirements. Exact one-to-one replacements for military specifications and standards are seldom available, thus it is up to the procuring agency and/or the contractor to determine which, if any, of the available non-government documents best suits the current need as a replacement.

In some cases there is no suitable replacement available. In a few of these instances, and where the need is the greatest, the Defense Standards Improvement Council (DSIC) has requested that a specific professional organization create such a document. Those professional organization efforts to generate commercial replacement documents are identified in this report, including those where "work is in progress."

Non-government replacement documents typically fall into one of three general categories:

- International standards.
- National standards (e.g. American National Standards Institute (ANSI) and Canadian Standards Association (CSA)).
- Professional society standards (e.g., Institute of Electrical and Electronics Engineers (IEEE) and Society of Automotive Engineers (SAE)).

In addition to strictly non-government documents, other documents, such as those developed by the National Aeronautics and Space Administration (NASA), the North Atlantic Treaty Organization (NATO), and other foreign military and national documents (e.g., British Ministry of Defence (MOD) and the British Standards Institution (BSI)) are available as potential replacements for the US military specifications and standards mentioned above.

More than 1,450 specifications and standards were reviewed as possible candidate replacement documents in the compilation of the report. The 1,450 plus documents were identified via key word searches of the International Handling System World Wide Standards Service. Key words used included: reliability, maintainability, availability, dependability, testability, logistics, and safety. The key word searches produced document titles and other information such as issuing organization, date of issue and original language titles. From this list, documents were selected for review and summarization in this report based on the following criteria:

- Consider only documents that are written for the system or subsystem level
- Available in English
- Not too industry or technology specific

Several documents were identified within the IHS system that were component specifications with a key word such as reliability in its title (e.g., "Capacitors, Fixed, Mica Dielectric, Established *Reliability*, General Specification For"). Such documents are clearly not R, M &A documents. Other documents that were R, M & A documents were identified but not reviewed simply because no English language version was available. All document titles, with information on issuing organization, that are

considered to be R, M & A documents, but were not reviewed due to one of the above criteria are listed in Appendix C.

Of all document titles reviewed, a total of 88 potential replacement documents were selected for review and summarization. They are grouped into nine categories of related documents together with references to the military specifications and standards which they might replace. The nine document categories (labeled as sections within the report) are as follows:

- Vocabularies, Glossaries, Terms and Parameters
- Design Guides and Handbooks
- Analysis Techniques
- Testing
- Maintainability
- Data Collection and Parts Information
- Products and Industry Specific Documents
- Management
- Requirements Development and Analysis

Individual chapters within each of the above sections contain individual summaries of, and significant details for, each potential replacement document. Included within each document summary are:

- Formal document title
- Page count
- Originating/distributing organization
- Price
- Outline of the document
- Document abstract
- Principal features of the document
- Document limitations/tailoring recommendations

In addition to those documents that are summarized, and in addition to the list provided in Appendix C, another list of R, M & A document titles specific to the Telecommunications industry is provided in Appendix D of the report. Although such documents would have been eliminated from consideration under the document selection criteria outlined previously, it was felt that due to the rapid growth of this industry, some consideration should be given in this report.

Ordering Information

Complete contact information is given for each standard generating/distributing organization responsible for one or more of the documents reviewed within this report. This includes: organization name, mailing address, telephone and facsimile numbers, E-Mail or World Wide Web (WWW) address, and ordering information.

Comprehensive Listing of Standards Generating Organizations

A more comprehensive world wide listing of applicable standards generating organizations, from which additional replacement documents might be considered, is also included. Appendix A covers those organizations within the United States and Appendix B those organizations outside of the United States.

Specific Military Document Changes Resulting from Acquisition Reform

Also addressed in this report is a summary of the U.S. military R, M & A specifications and standards changes resulting from Acquisition Reform. The data is current as of the date of publication of this report. However, since this is a very dynamic topic, WWW sites are identified where more current data is available to the reader.

TABLE OF CONTENTS

TABLE OF CONTENTS (CONT'D)

TABLE OF CONTENTS (CONT'D)

TABLE OF CONTENTS (CONT'D)

TABLE OF CONTENTS (CONT'D)

PAGE

TABLE OF CONTENTS (CONT'D)

TABLE OF CONTENTS (CONT'D)

TABLE OF CONTENTS (CONT'D)

TABLE OF CONTENTS (CONT'D)

TABLE OF CONTENTS (CONT'D)

PAGE

TABLE OF CONTENTS (CONT'D)

LIST OF TABLES

LIST OF APPENDICES

FOREWORD

This publication is intended to provide brief resumes of the most pertinent US and international commercial and government specifications, standards and handbooks dealing with reliability, maintainability, availability and dependability (R, M, A & D). It is addressed especially to program managers and other individuals who need a concise overview of the most important applicable documents available in the field. It thus provides the user with a single reference guide to the applicability and use of the most pertinent R, M, A, & D documents, thereby avoiding the need of separately ordering the documents from a variety of sources and then reviewing each document to determine its application to a given program. This feature should be especially helpful to individuals responsible for writing requests for proposals, individuals writing proposals in response, and to individuals evaluating proposals.

Section 1, Chapter 1, provides the reader with general information regarding the specifications and standards included. It also provides an overview of selected non-government specification and standards generating agencies and specific directions for ordering copies of their documents. A cross reference index of all the documents addressed by this publication, arranged by generating agency, is provided up front to aid the reader in quickly locating documents of interest.

The major portion of the material in the publication is grouped into sections of similar types of documents, irrespective of the generating organization, as follows:

Section 2: Vocabularies/Glossaries/Terms and Parameters
Section 3: Design Guides and/or Handbooks
Section 4: R & M Analysis Techniques
Section 5: Testing
Section 6: Maintainability
Section 7: Data Collection and Parts Information
Section 8: Unique to a Specific Product or Industry
Section 9: Management
Section 10: Requirements Development and Analysis

Each of the above sections includes chapters, wherein each chapter is a synopsis of a single R, M, A, or D document. Each chapter gives a brief description of the document, explains its principal features and gives a brief explanation of document limitations and recommendations on how to tailor the requirements of the document and when tailoring is applicable. The date of the most current version of the document

is also listed, as is the total number of pages contained in the document. Pricing information is also provided, however the Rome Laboratory does not guarantee the price shown will remain valid. Each document's price often depends on the agency selling the document. The prices shown were obtained from one or more of the following sources:

ANSI
11 W. 42nd Street
New York, NY 10036
Attn: Publication Sales
Phone: (212) 642-4900

Global Engineering Documents
M/S B201
15 Inverness Way, East
Englewood, CO 80112
Phone: (800) 854-7179

Always check, when possible, with the standards bodies responsible for a particular document for pricing. Address and phone numbers for each standards body are provided in this report.

Section 11 addresses the changes in the pertinent military documents resulting from acquisition reform. Section 12 addresses standards development work in progress by various professional organizations. Finally, Appendices A and B contain listings of various other standards generating organizations within and outside the United States, Appendix C contains a summary listing of all dependability-related standards identified during this effort, and Appendix D contains a summary listing of all dependability-related standards used specifically within the communications industry.

CROSS REFERENCE INDEX OF DOCUMENTS BY ISSUING ORGANIZATION

List of Issuing Organizations

American National Standards Institute (ANSI)

British Standards Institution (BSI)

British Ministry of Defense (MOD)

Canadian Standards Association (CSA)

Electronic Industries Association/Joint Electron Device Engineering Council (EIA/JEDEC)

Institute of Electrical and Electronics Engineers (IEEE)

Institute of Environmental Sciences

Institute for Interconnecting And Packaging Electronic Circuits (IPC)

International Electrotechnical Commission (IEC)

International Organization For Standardization (ISO)

National Aeronautics and Space Administration (NASA)

North Atlantic Treaty Organization (NATO)

Society of Automotive Engineers International (SAE)

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

DOCUMENT NUMBER AND TITLE	DOCUMENT CAN BE FOUND IN
500 - Guide to the Collection and Presentation of Electrical, Electronic, Sensing Component, and Mechanical Equipment Reliability Data for Nuclear-Power Generating Stations	Section 8: Page 8-3
577 - Standard Requirements for Reliability Analysis in the Design and Operation of Safety Systems for Nuclear Power Generating Stations	Section 8: Page 8-5
762 - Standard Definitions for Use in Reporting Electric Generating Unit Reliability, Availability, and Productivity	Section 8: Page 8-7
R-013 - Recommended Practice for Software Reliability	Section 8: Page 8-10
R15.05-3 - Industrial Robots and Robot Systems - Reliability Acceptance Testing - Guidelines	Section 8: Page 8-12
AIR 4276 - Survey Results: Computerization of Reliability, Maintainability and Supportability (RM&S) in Design	Section 9: Page 9-12

BRITISH MINISTRY OF DEFENSE (MOD)

DOCUMENT NUMBER AND TITLE	DOCUMENT CAN BE FOUND IN
DSTAN 00-5: Part 1 Design Criteria for Reliability, Maintainability and Maintenance of Land Service Material Part 1: General Requirements: Issue 3	Section 3: Page 3-21
DSTAN 00-5: Part 2 Design Criteria for Reliability, Maintainability and Maintenance of Land Service Material Part 2: Mechanical Aspects Issue	Section 3: Page 3-23
DSTAN 00-5: Part 3 Design Criteria for Reliability, Maintainability and Maintenance of Land Service Material Part 3: Electrical and Electronic Aspects: Issue 3	Section 3: Page 3-26
DSTAN 00-25: Part 11 Human Factors for Designers of Equipment Part 11: Design for Maintainability: Issue 1	Section 6: Page 6-22
DSTAN 00-43: Part 1 Reliability and Maintainability Assurance Activity Part 1: In-Service Reliability Demonstration Issue 1	Section 5: Page 5-38
DSTAN 00-44: Part 1 Reliability and Maintainability Data Collection and Clarification Part 1: Maintenance Data and Defect Reporting in the Royal Navy, the Army and the Royal Air Force: Issue 1	Section 7: Page 7-10
DSTAN 00-44: Part 2 Reliability and Maintainability Data Collection and Clarification Part 2: Data Classification and Incident Sentencing - General: Issue 1	Section 7: Page 7-14
DSTAN 00-60: Part 0 Integrated Logistics Support Part 0: Application of Integrated Logistics Support (ILS) Interim	Section 9: Page 9-16
DSTAN 00-60: Part 1 Integrated Logistics Support Part 1: Logistics Support Analysis LSA) and Logistics Support Analysis Record (LSAR) Interim	Section 10: Page 10-12
DSTAN 00-60: Part 2 Integrated Logistics Support Part 2: Guide to the Application of LSA and LSAR Interim	Section 9: Page 9-19
DSTAN 00-25: Part 20 Integrated Logistics Support Part 20: Integrated Supply Support Procedures (ISSP) Interim	Section 10: Page 10-14
DSTAN 05-48 Reliability of a Series System Issue 1	Section 4: Page 4-22

BRITISH STANDARDS INSTITUTION (BSI)

DOCUMENT NUMBER AND TITLE	DOCUMENT CAN BE FOUND IN
BS 4778 - Availability, Reliability and Maintainability Terms, Section 3.1, Guide to Concepts and Related Definitions	Section 2: Page 2-10
BS 5760: Part 0: 1986 Reliability of Constructed or Manufactured Products, Systems, Equipments and Components, Part 0: Introductory Guide to Reliability	Section 3: Page 3-29
BS 5760: Part 3: 1982 Reliability of Systems, Equipments and Components, Part 3: Guide to Reliability Practices: Examples	Section 3: Page 3-31
BSI Quality Management Handbook (QMH)	Section 3: Page 3-34
BS 5760: Part 2: Reliability of Systems Equipment and Components: Part 2: Guide to Assessment of Reliability	Section 4: Page 4-24
BS 5760: Part 5: Reliability of Systems Equipment and Components: Part 5: Guide to Failure Modes, Effects and Criticality Analysis (FMEA and FMECA)	Section 4: Page 4-29
DD198 - Assessment of Reliability of Systems Containing Software	Section 4: Page 4-31
BS 5760: Part 1: 1985 Reliability of Constructed or Manufactured Products Systems, Equipments and Components, Part 1. Guide to Reliability and Maintainability Programme Management	Section 9: Page 9-22
BS 5760: Part 4: 1986 Reliability of Constructed or Manufactured Products, Systems, Equipments and Components, Part 4. Guide to Specification Clauses Relating to the Achievement and Development of Reliability in New and Existing Items	Section 10: Page 10-17

CANADIAN STANDARDS ASSOCIATION (CSA)

DOCUMENT NUMBER AND TITLE	DOCUMENT CAN BE FOUND IN
Q633-90 - Reliability, Availability, and Maintainability Design Guide for Electronic Products	Section 3: Page 3-15
Q636-93 - Guidelines and Requirements for Reliability Analysis Methods	Section 3: Page 3-19
Q632-90 - Reliability and Maintainability Management Guidelines	Section 9: Page 9-14

ELECTRONIC INDUSTRIES ASSOCIATION/JOINT ELECTRON DEVICE ENGINEERING COUNCIL (EIA/JEDEC)

DOCUMENT NUMBER AND TITLE	DOCUMENT CAN BE FOUND IN
EIA/JEDEC JEP 70 - Quality and Reliability Standards, 1993	Section 8: Page 8-14

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

DOCUMENT NUMBER AND TITLE	DOCUMENT CAN BE FOUND IN
500 - Guide to the Collection and Presentation of Electrical, Electronic, Sensing Component, and Mechanical Equipment Reliability Data for Nuclear-Power Generating Stations	Section 8: Page 8-3
577 - Standard Requirements for Reliability Analysis in the Design and Operation of Safety Systems for Nuclear Power Generating Stations	Section 8: Page 8-5
762 - Standard Definitions for Use in Reporting Electric Generating Unit Reliability, Availability, and Productivity	Section 8: Page 8-7

INSTITUTE OF ENVIRONMENTAL SCIENCES (IES)

DOCUMENT NUMBER AND TITLE	DOCUMENT CAN BE FOUND IN
Environmental Stress Screening Guidelines For Assemblies	Section 5: Page 5-32

INSTITUTE FOR INTERCONNECTING AND PACKAGING ELECTRONIC CIRCUITS (IPC)

DOCUMENT NUMBER AND TITLE	DOCUMENT CAN BE FOUND IN
D-330 2.3.4.1 - Reliability (Design Guide)	Section 3: Page 3-4

INTERNATIONAL ELECTROTECHNICAL COMMISSION (IEC)

Note: All of the IEC documents reviewed contain both an English and French version in the same document.

DOCUMENT NUMBER AND TITLE	DOCUMENT CAN BE FOUND IN
50 Chap 191 - International Electrotechnical Vocabulary Chapter 191: Dependability and Quality of Service	Section 2: Page 2-3
300 - 1 - Dependability Management - Part 1: Dependability Programme Management	Section 9: Page 9-4
300 - 3-1 - Dependability Management Part 3: Application Guide Section 1: Analysis Techniques for Dependability: Guide on Methodology	Section 4: Page 4-3
300 - 3-2 - Dependability Management - Part 3: Application Guide - Section 2: Collection of Dependability Data from the Field	Section 7: Page 7-4
319 - Presentation Of Reliability Data on Electronic Components (or Parts)	Section 7: Page 7-6
409 - Guide for the Inclusion Of Reliability Clauses into Specifications for Components (or Parts) for Electronic Equipment	Section 7: Page 7-8
571 - 3 - Electronic Equipment Used on Rail Vehicles Part 3: Components, Programmable Electronic Equipment and Electronic System Reliability	Section 8: Page 8-16
605 - 1 - Equipment Reliability Testing - Part 1: General Requirements	Section 5: Page 5-4
605 - 2 - Equipment Reliability Testing - Part 2: Design Of Test Cycles	Section 5: Page 5-6
605 - 3-1 Equipment Reliability Testing - Part 3: Preferred Test Conditions Indoor Portable Equipment - Low Degree of Simulation	Section 5: Page 5-9

INTERNATIONAL ELECTROTECHNICAL COMMISSION (IEC) (CONT'D)

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

DOCUMENT NUMBER AND TITLE	DOCUMENT CAN BE FOUND IN
ISO 9000-4 Quality Management And Quality Assurance Standards - Part 4: Guide To Dependability Programme Management	Section 9: Page 9-4

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)

DOCUMENT NUMBER AND TITLE	DOCUMENT CAN BE FOUND IN
NASA NHB 5300.4 (1G) - Reliability, Maintainability, and Quality Assurance Publication, NASA Assurance Terms and Definitions	Section 2: Page 2-9
NASA NHB 5300.4 (1E) - Reliability, Maintainability, and Quality Assurance Publication, Maintainability Program Requirements for Space System	Section 6: Page 6-19
NASA NHB 5300.9 - Safety, Reliability, and Quality Assurance Provisions for the Office of Aeronautics, Exploration and Technology Centers	Section 3: Page 3-44
NASA NHB 5300.4 (1A-1) - Reliability Program Requirements for Aeronautical and Space System Contractors	Section 9: Page 9-30

NORTH ATLANTIC TREATY ORGANIZATION (NATO)

DOCUMENT NUMBER AND TITLE	DOCUMENT CAN BE FOUND IN
ARMP-2, Edition No. 2: General Application Guidance on the Use of ARMP 1	Section 3: Page 3-41
ARMP-4, Edition No. 1: Guidance For Writing NATO R&M Requirements Documents	Section 10: Page 10-3
ARMP-5: Guidance On Reliability And Maintainability Training	Section 10: Page 10-6
ARMP-6: In-Service R & M	Section 10: Page 10-8
ARMP-8: Reliability & Maintainability In The Procurement Of Off-The-Shelf Equipment	Section 10: Page 10-10
Standardization Agreement (STANAG) 4288 (Draft, Edition 1) Design Criteria To Facilitate Test Capability For NATO Communications And Associated Electronic Subassemblies In NATO Depots	Section 3: Page 3-17
ARMP-1: Edition 2: NATO Requirements for Reliability and Maintainability	Section 9: Page 9-27

SOCIETY OF AUTOMOTIVE ENGINEERS (SAE)

DOCUMENT NUMBER AND TITLE	DOCUMENT CAN BE FOUND IN
ARD 50010 - Recommended RMS Terms And Parameters	Section 2: Page 2-5
J 1213/2 - Glossary of Reliability Terminology Associated with Automotive Electronics, Information Report	Section 2: Page 2-7
AE-9 - Automotive Electronics Reliability Handbook	Section 3: Page 3-6
ARD 50046 - RMS Information Sourcebook	Section 3: Page 3-10
M-102 - Reliability, Maintainability, and Supportability Guidebook	Section 3: Page 3-12
AIR 4845 - The FMECA Process in the Concurrent Engineering (CE) Environment	Section 4: Page 4-17

SOCIETY OF AUTOMOTIVE ENGINEERS (SAE) (CONT'D)

DOCUMENT NUMBER AND TITLE	DOCUMENT CAN BE FOUND IN
J 1739 - Potential Failure Mode And Effects Analysis in Design (Design FMEA) and Failure Mode And Effects Analysis in Manufacturing and Assembly Processes (Process FMEA) Reference Manual, Recommended Practice	Section 4: Page 4-19
HS-2600 - SAE Maintainability, Reparability, and Serviceability Standards Manual	Section 6: Page 6-17
M-110 - Reliability and Maintainability Guideline for Manufacturing Machinery and Equipment	Section 8: Page 8-21
AIR 4276 - Survey Results: Computerization of Reliability, Maintainability and Supportability (RM&S) in Design	Section 9: Page 9-12

SECTION 1
INTRODUCTION

CHAPTER 1: GENERAL INFORMATION ON SPECIFICATIONS AND STANDARDS

1.1 Purpose

1.2 Scope

1.3 Background Information

1.4 Specifications and Standards Generating Organizations
- 1.4.1 National Aeronautics and Space Administration (NASA)
- 1.4.2 North Atlantic Treaty Organization (NATO)
- 1.4.3 British Standards Institution (BSI)
- 1.4.4 British Ministry of Defence (MOD)
- 1.4.5 American National Standards Institute (ANSI)
- 1.4.6 Canadian Standards Association (CSA)
- 1.4.7 Institute of Electrical & Electronics Engineers (IEEE)
- 1.4.8 Institute for Interconnecting and Packaging Electronic Circuits (IPC)
- 1.4.9 International Electrotechnical Commission (IEC)
- 1.4.10 Society of Automotive Engineers International (SAE)
- 1.4.11 Institute of Environmental Sciences
- 1.4.12 International Organization for Standardization (ISO)
- 1.4.13 Electronic Industries Association (EIA)

1.5 Format of Succeeding Chapters

CHAPTER 1: GENERAL INFORMATION ON SPECIFICATIONS AND STANDARDS

1.1 Purpose

When first introduced to a major system or equipment development/procurement program containing Reliability, Maintainability, Availability and/or Dependability requirements, it is easy to become dismayed by the number and variety of specifications and standards, and standards generating agencies from which to choose. (See Appendix A and B.)

The purpose of this publication is to assist the reader in this arduous task by pulling together in a single location summaries of several non-US military, both government and non-government, specifications, standards, and other related documents such as guides and handbooks dealing with Reliability, Maintainability, Availability and Dependability (R, M, A and D).

1.2 Scope

All documents synopsized in this publication should be considered for application (with suitable tailoring) to system and equipment development and procurement programs for both military and non-military equipment. Although some of the documents reviewed are related to software reliability, documents primarily written for development of reliable, maintainable or dependable software are not within the scope of this publication. Software is a separate issue that will be considered at a later point in time.

Since all of the documents are continually undergoing change, this publication may become outdated with time; thus we have endeavored to indicate clearly the most current issue of each document and the manner by which the issuing agency indicates revisions and updates to the document. Although we have endeavored to address the current issue of each document at the time of this publication, the reader is cautioned to verify the latest revision to the document prior to referencing or utilizing the document in a specific procurement.

All of the material in this publication is only advisory in nature regarding all documents referenced herein. This document does not supersede, modify, replace or curtail any of the requirements set forth in these documents.

1.3 Background Information

On June 29, 1994 Dr. William J. Perry, US Secretary of Defense, issued a memorandum titled, "Specifications and Standards -- A New Way of Doing Business." In this memo, Dr. Perry directed the use of "Performance-Based Specifications and Standards or Nationally-Recognized Private Sector Standards" in lieu of the historic Military Specification approach where practical in future Department of Defense (DoD) procurements. Under this directive the automatic imposition of military unique specifications or standards is explicitly prohibited. Military specifications and standards may be used only as a last resort in DoD acquisitions when performance-based specifications and/or commercial standards would not meet program needs, and then a waiver is required for their use. This prohibition applies only to actions by the government. It does not prohibit a bidder from referencing military specifications and standards in response to a solicitation.

A performance-based specification is defined as one that states requirements in terms of the required results with criteria for verifying compliance, but without stating the detailed methods for achieving the required results. A performance-based specification defines the functional requirements for the item, the environment in which it must operate, and interchangeability characteristics. Types of performance-based specifications include: Commercial Item Descriptions, Guide Specifications, Standard Performance Specifications, and Program Peculiar Performance Specifications.

As a direct result of this change in direction, many of the best known military specifications and standards historically called out for dealing with R, M, A & D requirements are expressly prohibited and some of them are scheduled to be canceled. Specific examples of now prohibited reliability and maintainability specifications and standards include: MIL-STD-470 "Maintainability Program for Systems and Equipment," MIL-STD-781 "Reliability Testing for Engineering Development, Qualification and Production," MIL-STD-785 "Reliability Program for Systems and Equipment Development and Production," MIL-STD-965 "Parts Control Program" and many others.

This global shift in the use of historic military specifications and standards in DoD procurements, the growing use of Non-Developmental Items (NDI) and the use of "Best Commercial Practices" in military applications, and the growing recognition of the need to deal with R, M, A & D requirements in commercial equipment and system procurements has generated a sudden new interest in non-government specifications and standards for R, M, A & D.

1.4 Specifications and Standards Generating Organizations

Throughout the world there are numerous specifications and standards generating organizations. In this publication we have elected to include US and international commercial specifications and standards. Included are standards, specifications, and other relevant documents issued by the National Aeronautics and Space Administration (NASA), the North Atlantic Treaty Organization (NATO), the British Standards Institution (BSI) and the British Ministry of Defence (MOD). In addition to these organizations, documents issued by the following non-military and non-government organizations are included: the American National Standards Institute (ANSI), the Institute of Electrical & Electronics Engineers (IEEE), the International Electrotechnical Commission (IEC), the Institute for Interconnecting and Packaging Electronic Circuits (IPC), the Society of Automotive Engineers International (SAE), the Canadian Standards Association (CSA), the Electronics Industries Association/Joint Electron Device Engineering Council (EIA/JEDEC), the Institute of Environment Sciences, and the Robotics Industry Association (RIA).

The above organizations are obviously not the only ones generating R, M, A & D specifications and standards. Other standards bodies either did not publish English language versions of their standards, or did not publish standards that were applicable to systems. Because of the numerous standards for parts and other levels of indenture, an objective of this publication was to review documents that were primarily targeted to the system-level. This ensures a wider audience for the publication while keeping the scope of the effort involved at a workable level. Appendix C provides a comprehensive list of the documents and standards generating organizations initially reviewed as part of the effort to produce this publication.

Two other organizations should be mentioned at this junction because of their overall significance to the task at hand, the American Society for Quality Control

(ASQC) and the International Organization for Standardization (ISO). They are not included in this list, however, because (with the exception of ISO 9000-4) they have not as yet published specifications or standards dealing specifically with R, M, A & D. A brief synopsis of each organization who's standards are reviewed in this publication follows.

1.4.1 National Aeronautics and Space Administration (NASA)

NASA is currently in the process of reviewing their handbooks. These are being suspended, simplified where possible, and replaced with documents known as NASA Procedural Guidelines (NPG). In some instances, the information is being split into two documents, one for policy, NASA Policy Directives (NPDs), and one for procedures (NPGs). The ordering address for documents from NASA is:

NASA Center for Aerospace Information
800 Elkridge Landing Road
Linthicum Heights, MD 21090-2934

Tel: (301) 621-0134
Fax: (301) 621-0100

1.4.2 North Atlantic Treaty Organization (NATO)

The Military Agency for Standardization (MAS) is the principal agency for standardization within NATO. Formed in London in 1951, its purpose is to facilitate operational, procedural and materiel standardization among member nations to enable NATO forces to operate together in the most effective manner. Cooperation between international technical expert groups and the MAS is effected through the NATO Standardization Group and by liaison with NATO's International Staff and International Military Staff. Most standards produced by NATO are called Standardization Agreements (STANAG).

The ordering address for documents from NATO is:

North Atlantic Treaty Organization (NATO)
Ministry of Defense
Kentigern House
65 Brown Street
Glasgow, United Kingdom G2 8EX

Tel: +(44) 141 248 7890

1.4.3 British Standards Institution (BSI)

The BSI is the independent national body responsible for preparing British Standards. It presents the United Kingdom (UK) view on standards in Europe and at the international level.

The ordering address for documents from BSI is:

British Standards Institution (BSI)
Sales Department
Linford Wood
Milton Keynes, United Kingdom MK14 6LE

Tel: +(44) 190 822 1166
Fax: +(44) 190 832 0856
World Wide Web Home Page: http://www.bsi.org.uk/

1.4.4 British Ministry of Defence (MOD)

The MOD publishes standards through its Directorate of Standardization. Copyright to all such Defense Standards (DSTANs) is held by Her Majesty's Stationery Office (HMSO). Crown copyright material is reproduced with the permission of the Controller of Her Majesty's Stationery Office.

The ordering address for documents from MOD is:

AD/STAN
Ministry of Defence (MOD)
Kentigern House
65 Brown Street
Glasgow, Scotland, G2 8EX
Tel: +(44) 141 218 9000

1.4.5 American National Standards Institute (ANSI)

Founded in 1918, The American National Standards Institute (ANSI) is a private, nonprofit membership organization responsible for coordinating the United States voluntary consensus standards systems and approving American National Standards. Other professional organizations voluntarily submit standards to ANSI for approval. ANSI standards are widely used on a voluntary basis. Many ANSI standards have also

been adopted for use by the Department of Defense (DoD). ANSI standards are available in hard copy, on microfilm and on CD-ROM.

ANSI also participates in the development of, and subsequent adoption of, standards developed by international organizations such as the International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC).

The ordering address for documents from ANSI is:

American National Standards Institute
Attn: Customer Service
11 West 42nd Street
New York, NY 10036

Tel: (212) 642-4900
FAX: (212) 302-1286
World Wide Web Home Page: http://www.ansi.org/home.html

International customers may expedite delivery of their orders by dealing with international sales agents in England, Canada or Japan.

1.4.6 Canadian Standards Association (CSA)

The Canadian Standards Association is a standards writing and conformity assessment organization that offers services in consensus standards and guideline development for more than 37 technology fields, as well as conformity assessment services in product testing, certification, and quality systems registration.

The ordering address for documents from the CSA is:

Canadian Standards Association (CSA)
178 Rexdale Boulevard
Rexdale Toronto
Ontario M9W 1R3, Canada

Tel: (416) 747-4000
Fax: (416) 747-4149

1.4.7 Institute of Electrical & Electronics Engineers (IEEE)

The IEEE is the largest professional organization of its type in the world. It came into being as a result of the merger of the Institute of Radio Engineers (IRE) and the American Institute of Electrical Engineers (AIEE) in 1963.

The IEEE Standards Press publishes a broad range of publications pertaining to standards and their implementation, covering electrical engineering, electronics and computer technology. It is one of the major contributors to the field of electrical and electronic specifications and standards. A significant number of these standards have also been recognized by ANSI.

The ordering address for documents from the IEEE is:

IEEE
445 Hoes Lane
P.O. Box 1331
Piscataway, NJ 08855-1331

Telephone: (800) 678-IEEE
Outside the US & Canada: (908) 981-1393
FAX: (908) 981-9667
E-mail: stds.info@ieee.org
World Wide Web Home Page: http://www.ieee.org/

1.4.8 Institute for Interconnecting and Packaging Electronic Circuits (IPC)

The IPC is a US based trade association with international membership representing manufacturers and users of printed boards, flat cables, discrete wiring, hybrid circuits and companies who assemble printed boards. Members also include suppliers to the industry, government agencies and educational institutions.

The ordering address for documents from the IPC is:

IPC
7380 N. Lincoln Ave.
Lincolnwood, IL 60646-1705

Tel: (708) 677-2850
FAX: (708) 677-9570
World Wide Web Home Page: http://www.automata.com/ipc/index.html

1.4.9 International Electrotechnical Commission (IEC)

The IEC is the major international body responsible for standards within the electrotechnical field. It is also the oldest international standards organization, created in 1906. The Council, the governing body of the IEC, comprises representatives from 49 member countries. The IEC is headquartered in Geneva, Switzerland and has some 300 technical committees.

Within the IEC, Technical Committee 56 (IEC/TC56), established in 1965, is the group most concerned with R, M, A & D documents. To date this committee has produced more than 30 world standards on reliability and related characteristics.

IEC/TC56 has decided to use the word "**Dependability**" rather than "Reliability" in dealing with Reliability, Availability, and Maintainability, and they are currently revising their documents accordingly. Hence, the reference to the word "Dependability" in this publication.

A unique feature of the IEC documents is the fact that they are typically printed in multi-lingual editions containing the English and French, or the English, French and Russian or other language versions within a single volume.

Within the United States, IEC documents are available from ANSI. See Section 1.4.2 for ordering information.

In Canada IEC documents may be ordered from:

Standards Council of Canada
Standards Sales Division
350 Sparks St. Suite 1200
Ottawa, Ontario K1P 6N7

Tel: (613) 238-3222
FAX: (613) 995-4564

IEC documents may also be purchased (priced in Swiss Francs) directly from:

Sales Dept.
IEC Central Office
P.O. Box No. 131
3 rue de Varembé
1211 Geneva 20 Switzerland

Tel: +41 22 919 02 11
FAX: +41 22 919 03 00
EMail: dn@iec.ch

1.4.10 Society of Automotive Engineers International (SAE)

The SAE is the major worldwide source of information and expertise used in designing, building, testing, marketing, maintaining and operating self-propelled vehicles, whether land, sea, air, or space-based. Within the SAE, the Reliability, Maintainability & Supportability (RMS) Committee (G-11), chartered in 1986, is one of the most active contributors.

The ordering address for documents from the SAE is:

Publications Sales
SAE International
400 Commonwealth Drive
Warrendale, PA 15096-0001

Tel: (412) 776-4970
FAX: (412) 776-5760

1.4.11 Institute of Environmental Sciences

The Institute of Environmental Sciences is an international technical society, founded in 1956, with more than 3,800 members worldwide. Headquartered in Mount Prospect, IL, the society consists of four divisions: contamination control, design, test and evaluation, product reliability, and energy and environment.

The ordering address for the Institute of Environmental Sciences is:

Institute of Environmental Sciences
940 East Northwest Highway
Mount Prospect, IL 60056

Tel: (700) 255-1561
FAX: (708) 255-1699

1.4.12 International Organization for Standardization (ISO)

ISO is a worldwide federation of national standards bodies from some 100 countries, one from each country. ISO is a non-governmental organization established in 1947. The mission of ISO is to promote the development of standardization and related activities in the world with a view to facilitating the international exchange of goods and services, and to developing cooperation in the spheres of intellectual, scientific, technological and economic activity. ISO's work results in international agreements which are published as International Standards.

The ordering address for ISO is:

International Organization for Standardization (ISO)
1, Rue de Varembé
CH-1211 Geneva 20, Switzerland

Tel: +(41) 22 749-0111
FAX: +(41) 22 733-3430

1.4.13 Electronic Industries Association (EIA)

For more than 72 years, the EIA has been the national trade organization representing U.S. electronics manufacturers. Committed to the competitiveness of the American producer, EIA represents the entire spectrum of companies involved in the design and manufacture of electronic components, parts, systems and equipment for communications, industrial, government and consumer uses. The one document reviewed herein, is a joint document with the Joint Electron Device Engineering Council (JEDEC).

The ordering address for EIA is:

Electronic Industries Association
2500 Wilson Blvd.
Arlington, VA 22201

Tel: (703) 907-7500

1.5 Format of Succeeding Sections

The material in each of the succeeding sections of this publication has been organized into chapters having a common format to assist the reader in quickly finding desired information. This format, together with a brief description of the type of material to be found in each applicable chapter section, is summarized as follows:

CHAPTER SECTION*	TITLE AND CONTENTS
X.0	Document Identification: Issuing Organization, Official Title, Date of Current Issue and History of Revisions (as necessary) and Price**
X.1	Outline of Document
X.2	Abstract of Document: Brief description of document contents, purpose and scope
X.3	Principal Features of the Document: Synopsis of significant information and features found in the document
X.4	Limitations/Tailoring Recommendations: Description of any limitations in scope or applicability and recommendations for tailoring, if warranted.

*X = Chapter number within a section.

** The price quoted is from the best available source at the time of publication of this document. IEC documents priced in US dollars are from the ANSI catalog, prices in CHF (Swiss Francs) are for the English version, where the option is available, from the IEC catalog.

1.6 Copyright Information

For each of the standards, handbooks, guides and other documents reviewed in this report, a minimal amount of information from each document, limited to the Table of Contents (shown as document outline) and selected quotes, have been reprinted verbatim. Therefore, Rome Laboratory (RL) contacted and obtained permission to use this information from each of the relevant standards organizations. The terms of usage are noted here, and by reference in each of the chapters within Sections 2 through 10.

1.6.1 American National Standards Institute (ANSI)

All of the ANSI documents reviewed were joint standards with one or more of the following organizations. In all cases, ANSI did not hold copyrights and therefore permission was sought and granted from those organizations listed below. Refer to the subsections listed in parenthesis next to the organization for more information:

IEEE (see Section 1.6.6)
AIAA*
RIA (see Section 1.6.12)
SAE (see Section 1.6.13)

1.6.2 British Standards Institution (BSI)

Permission was granted via letter from Mr. P. Danvers, Copyright Manager. Mr. Danvers granted permission for the inclusion of the BSI standard number and title; the abstract as found in the BSI catalogue, and the contents page from relevant standards, but not any text.

1.6.3 British Ministry of Defense (MOD)

Permission was granted by Her Majesty's Stationary Office (HMSO) in memorandum of agreement number COA 27/1004 between the HMSO and IIT Research Institute, operators of the Reliability Analysis Center (RAC). The following statement applies to all MOD documents herein:

"Crown copyright material is reproduced with the permission of the Controller of Her Majesty's Stationery Office."

1.6.4 Canadian Standards Association (CSA)

Permission was granted in a letter signed by Mr. Lance Narak, Manager, Sales and Acquisition for CSA. Permission was granted for those CSA documents reviewed herein under the following conditions:

1. This arrangement is limited to these CSA publication editions only, to the extent and for the purposes cited in a correspondence letter of May 30, 1996.

*At the time of report publication, copyright permission from the AIAA was not yet obtained.

2. The following credit statements will be displayed along side any material reproduced:

"Reproduced with the permission of the Canadian Standards Association, and copyrighted by CSA, 178 Rexdale Blvd., Etobicoke, Ontario, M9W 1R3."

1.6.5 Electronic Industries Association/Joint Electron Device Engineering Council (EIA/JEDEC)

Permission was granted from Cece Fleming of EIA/JEDEC in an e-mail message sent to the RAC. Permission is contingent upon limiting EIA/JEDEC copyrighted material to less than 20% of this document.

1.6.6 Institute of Electrical and Electronics Engineers (IEEE)

Permission was granted in a letter signed by Cheryl J. Rowden, Administrator - Intellectual Property for the IEEE. As the information (i.e., Table of Contents and selected quotes) reprinted herein is of the type the IEEE normally makes freely available, they did not require any specific disclaimer notices.

1.6.7 Institute of Environmental Sciences

Permission was granted in a letter that was faxed to the Reliability Analysis Center (RAC) from Janet A. Ehmann, Executive Director for the Institute of Environmental Sciences. Permission was granted subject to providing proper credit to the initial source of publication.

1.6.8 Institute for Interconnecting and Packaging Electronic Circuits (IPC)

Permission was granted in a letter signed by Mr. David W. Bergman, Technical Director for the IPC. No specific disclaimer or other notice was required.

1.6.9 International Electrotechnical Commission/International Organization for Standardization (IEC/ISO)

The IEC/ISO granted permission to reprint the Table of Contents from selected standards in Copyright License Number ROMLAB/1INC/1996. Copyright statements appear on each page herein where the licensed material appears. Also as part of the

license agreement, information on each of the IEC/ISO member bodies is provided. This information can be found in Appendix E.

1.6.10 National Aeronautics and Space Administration (NASA)

Permission was granted from Mr. Mark Jeschke, Manager, Publications and Editorial Services, NASA Center for Aerospace Information in an e-mail message sent to the RAC. Portions of the referenced message relevant to the subject of copyright permissions are provided below.

NASA documents are not protected by copyright unless noted. If copyrighted, permission should be obtained directly from the copyright owner prior to use. If not copyrighted, documents may be reproduced and distributed without further permission from NASA.

The following general conditions also apply:

- NASA material may not be used to state or imply the endorsement by NASA or by any NASA employee of a commercial product, service or activity, or used in any other manner that might mislead.
- NASA should be acknowledged as the source of its material.
- It is unlawful to falsely claim copyright or other rights of NASA material.
- NASA shall in no way be liable for any costs, expenses, claims or demands arising out of use of NASA's documents, cassettes and photographs by a recipient or a recipient's distributees.
- NASA personnel are not authorized to sign indemnity or hold harmless statements, releases from copyright infringement, or documents granting exclusive use rights.

1.6.11 North Atlantic Treaty Organization (NATO)

The NATO ARMP documents reviewed do not have copyright restrictions. In fact, cover sheets for these documents have a statement that grants permission to freely distribute them. Therefore, permission to reprint Table of Contents and any selected

text was not required. This was confirmed by RL in conversations with Mr. Jean Roberti at NATO headquarters in Brussels.

1.6.12 Robotics Industries Association (RIA)

Permission was granted from Mr. Jim Peyton, Manager of Standards Development for RIA in an e-mail message to the RAC. No specific disclaimer or other notice was required.

1.6.13 Society of Automotive Engineers International (SAE)

Permission was granted in a letter signed by LaVerne M. Winkowski, Manager, Electronic Publishing Division of the SAE. No specific disclaimer or other notice was required.

SECTION 2
VOCABULARIES/GLOSSARIES/TERMS AND PARAMETERS

PREFACE

This section contains reviews of documents that should be used as reference sources on reliability, maintainability, availability and other dependability terms. The use of a common source of definitions is often important to facilitate communications within a specific industry or company, or between the buyer and seller of a product. Use of common definitions for dependability (i.e., R, M, A, etc.) parameters, such as mean time between failure (MTBF), operational availability or fault coverage are important to define up front in a procurement program to avoid confusion and argument in later stages of the acquisition. These documents should be referred to in this manner accordingly, to facilitate communication as described.

US Military standards and documents that fall within the category of Vocabularies/Glossaries/ Terms And Parameters are listed below. The current status of these documents under DoD Acquisition Reform can be found in Section 11, Chapter 1.

- MIL-STD-721 Definitions of Terms for Reliability and Maintainability

Chapter 1 IEC **50 CHAP 191**

International Electrotechnical Vocabulary Chapter 191: Dependability and Quality of Service, First Edition, 1990

Chapter 2 SAE **ARD 50010**

Recommended Reliability Maintainability and Supportability Terms and Parameters, 1994

Chapter 3 SAE **J 1213/2**

Glossary of Reliability Terminology Associated with Automotive Electronics, Information Report, October 1988

Chapter 4 NASA **NHB 5300.4 (1G)**

Reliability, Maintainability, and Quality Assurance Publication, NASA Assurance Terms and Definitions, May 1993

Chapter 5 **BS 4778**

Availability, Reliability and Maintainability Terms, Section 3.1, Guide to Concepts and Related Definitions

CHAPTER 1: IEC 50 CHAP 191 - INTERNATIONAL ELECTROTECHNICAL VOCABULARY CHAPTER 191: DEPENDABILITY AND QUALITY OF SERVICE*

*Identical to BSI Document BS 4778: Section 3.2: 1991 - Quality Vocabulary: Availability, Reliability and Maintainability Terms: Glossary of International Terms.

This document is dated 1990 and contains 135 pages. Price: $163.00 (175 CHF)

1.1 Outline of Document[♦]

Foreword

Preface

List of Symbols and Abbreviations

Part 1: Dependability: Common Terms. Section 191-01 to 191-18
- 191-01 Fundamental concepts
- 191-02 Item related performance
- 191-03 Defects (under consideration)
- 191-04 Failures
- 191-05 Faults, errors and mistakes
- 191-06 Item related states
- 191-07 Maintenance
- 191-08 Maintenance related times
- 191-09 Item state related times
- 191-10 Reliability performance measure related times
- 191-11 Availability performance measures
- 191-12 Reliability performance measures
- 191-13 Maintainability and maintenance support performance measures
- 191-14 Test concepts
- 191-15 Design concepts
- 191-16 Analysis concepts
- 191-17 Improvement processes
- 191-18 Measure modifiers

Part 2: Quality of Service in Telecommunications. Section 191-19 and 191-20
- 191-19 Service related performance
- 191-20 Time concepts related to interruptions

Index

1.2 Document Abstract

This standard forms Chapter 191 of the International Electrotechnical Vocabulary (IEV) and provides a glossary of terms relating to dependability and quality of service. It was prepared by Working Group Y of JCG (Joint Coordination Group of the IEC and the ITU [International Telecommunication Union]) and by Working Group 1 of IEC Technical Committee No. 56: Reliability and Maintainability, under the responsibility of IEC Technical Committee No. 1: Terminology.

1.3 Principal Features of the Document

This document is one portion of an International Electrotechnical Vocabulary which deals with Dependability and Quality of service. All the words and definitions are grouped in main topics as listed in the Outline of Document section above. This document is available in French, English, Spanish and Russian.

1.4 Limitations/Tailoring Recommendations

Due to the international flavor of IEC documents they should be capable of being effectively utilized in a wide variety of industries.

CHAPTER 2: SAE ARD 50010 - AEROSPACE RESOURCE DOCUMENT: RECOMMENDED RELIABILITY, MAINTAINABILITY AND SUPPORTABILITY TERMS AND PARAMETERS

This document is dated July 1994 and contains 42 pages. Price: $50.00

2.1 Outline of Document

1. Introduction

2. Approach
   - 2.1 Discussion of data base generation
   - 2.2 Selection/Recommendation process
   - 2.3 Subcommittee consensus process

3. How to read this report
   - 3.1 Sample report page
   - 3.2 Contents of published report

4. Appendices
   - Appendix A - List of documents reviewed
   - Appendix B - Planned document reviews
   - Appendix C - Planned data element expansion
   - Appendix D - List of recommended terms

2.2 Document Abstract

This document provides a glossary of terms utilized in the aerospace industry. The terms used in most engineering technologies tend to be physical characteristics such as speed, rate of turn and fuel consumption. While they may require very careful definition and control of the way in which they are measured, the terms themselves are not subject to different interpretations. Reliability, Maintainability and Supportability (RMS) however, use terms that are mathematically defined. As a result, there are more than 2000 terms defined, many of which have multiple interpretations.

2.3 Principal Features of the Document

Existing military and commercial documents, both domestic and foreign, which contain RMS terms and definitions were reviewed. A list of these documents is provided in Appendix A of the document.

Terms identified and extracted from the selected documents were reviewed for their applicability to the RMS fields and assembled into a database found in Appendix D of the document. For many terms, more than one definition was found in the selected documents. In these instances, one definition was selected as the preferred definition if it met the following criteria: clarity, completeness, general application. Where equivalent definitions were found in more than one definition, one of which being a military standard (MIL-STD), the preferred definition was that contained in the military standard.

The criteria applied for retention in the "database of applicable terms" are:

- Those with definitions specific to, or closely associated with the RMS disciplines.

- Those whose definitions are needed to support or qualify the definitions of specific RMS terms.

- The following types of terms were excluded from the data base of applicable terms: common engineering terms, e.g. fatigue, angle of incidence and most statistical terms.

2.4 Limitations/Tailoring Recommendation

The terms and parameters presented are applicable to any aerospace system. The document is best used as a reference but could be used to define terms in a requirements document.

CHAPTER 3: SAE J1213/2 - GLOSSARY OF RELIABILITY TERMINOLOGY ASSOCIATED WITH AUTOMOTIVE ELECTRONICS, INFORMATION REPORT

This document is dated October 1988 and contains 44 pages. Price: $45.00

3.1 Outline of Document

1. Introduction
2. Scope
3. References
4. Reliability Glossary
5. Acronyms, Abbreviations And Symbols

3.2 Document Abstract

This information report is a glossary of reliability and related terms that should be familiar to those working in reliability of automotive electronics. Also included is a list of acronyms, abbreviations and symbols.

3.3 Principal Features of the Document

The glossary was, ". . . compiled to assist, by serving as a reference, in the communication between the automotive electronics engineer and the reliability engineer." Many of the terms, and their definitions, were drawn from military and other commercial standards and documents. These sources are sighted as references or alternatives to the information provided.

3.4 Limitations/Tailoring Recommendations

Many of the terms, abbreviations, acronyms and symbols presented are applicable to any kind of electronic system. The document is best used as a reference, but could be used to define terms used in a requirements document. Caution must be exercised, however, if this document is referenced as part of a requirements document. Rather than referencing the whole document, wording such as ". . . where failure is as defined in SAE J1213/2 . . ." should be used. The primary reason for this recommendation is that some of the definitions appear to be taken from documents that may be specific to

certain assumptions and will, therefore, not be applicable to all situations. Further, some definitions are examples, and not true definitions.

CHAPTER 4: NASA NHB 5300.4 (1G) - RELIABILITY, MAINTAINABILITY, AND QUALITY ASSURANCE PUBLICATION, NASA ASSURANCE TERMS AND DEFINITIONS

This document is dated May, 1993 and contains 51 pages. Price: (Contact NASA for Pricing)

4.1 Outline of Document

1. Preface
2. Document Referencing
3. Paragraph Referencing
4. Organization of the RM&QA Manual
5. Overall Coverage

4.2 Document Abstract

This publication provides a compendium of commonly used safety, reliability, maintainability, and quality assurance (SRM&QA) definitions to ensure standardized assurance communications among NASA Field Installations, Headquarters, and Contractors.

4.3 Principal Features of the Document

This list of standard assurance terms and definitions was intended to be utilized by all NASA organizations and contractors. More than 570 terms and definitions are included.

4.4 Limitations/Tailoring Recommendations

Program/project tailoring of these definitions is anticipated for specific program applications.

CHAPTER 5: BS 4778: SECTION 3.1: 1991: QUALITY VOCABULARY, PART 3. AVAILABILITY, RELIABILITY AND MAINTAINABILITY TERMS, SECTION 3.1 GUIDE TO CONCEPTS AND RELATED DEFINITIONS

This document is dated 1991, and contains 26 pages. Price: $109.50

5.1 Document Outline

Committees responsible
Foreword

Section 1. General
- 1 Scope
- 2 Arrangement
- 3 Terms which merit special note
- 4 References

Section 2. Hazard, risk and safety
- 5 Relationship of terms
- 6 Hazard
- 7 Risk
- 8 Risk management
- 9 Economic risk
- 10 Hazard and risk to the environment
- 11 Safety

Section 3. Availability
- 12 Availability

Section 4. Reliability
- 13 Reliability
- 14 Reliability characteristics

Section 5. Maintainability
- 15 Maintainability

Section 6. Maintenance
- 16 Maintenance
- 17 Time analyses of maintenance

Section 7. ARM data and characteristics
- 18 ARM data
- 19 ARM characteristics

Section 8. ARM improvement
20 ARM management and assurance processes and programmes

Section 9. Human aspects of reliability
21 Human reliability

Section 10. Reliability and software
22 Programmable system software

Appendix A
English words and commonly used terms

5.2 Document Abstract

The objective of this document is to act as a reference for defining concepts and selected terms that are related to Availability, Reliability, and Maintainability (ARM). Definitions of several terms referred to in this document are provided in Section 3.2 of BS 4778, 1991 Glossary of International Terms, which is identical to IEC Publication 50: International Electrotechnical Vocabulary Chapter 191: Dependability and Quality of Service.

5.3 Principal Features of the Document

This document provides definitions and discussions of concepts directly and indirectly related to availability, reliability and maintainability (ARM). In each case, one or more basic concepts or terms are defined. As a minimum, the basic notion of each area presented (e.g., hazard, risk, safety, maintainability, human reliability, etc.) is discussed as to its meaning and application. As presented, this guide represents a good reference source in understanding the objectives and meaning behind several ARM related concepts. Several items within each concept are listed and reference is provided for where such items are defined in Section 3.2 of BS 4778. Section 3.2 is identical to IEC 50: 191, which is reviewed in Section 2 of this document.

Some interesting concepts defined within this document include economic risks, hazard and risk to the environment, a discussion of fault mode versus failure mode, and failure mechanism versus fault mechanism. Human reliability is also discussed from the standpoint of assessing how to control human error that may lead to unexpected performance error within the system being designed.

5.4 Limitations/Tailoring Recommendations

This document is best used as a reference source and is not designed to be a tailored document. It will provide a good common source of definitions that could be referenced in a specification or statement of work (SOW). For instance, "failure mode shall be as defined in BS 4778 Section 3.1, 1991 ... " There are no real limitations to the use of this document, however, some of the sections, such as that on maintainability, do not go into as much detail as others, and therefore for certain factors, additional reference sources may need to be consulted.

SECTION 3
GUIDES AND HANDBOOKS

PREFACE

This section contains reviews of documents that can be used as R&M design guides or handbooks. Both design guides and handbooks are guidance documents that provide engineering or other technical information, lessons learned, possible options to resolve technical issues, classification of similar items, interpretive direction and techniques, and other types of guidance or information. The purpose is to help the customer or the seller to design, construct, select, manage, support, or operate systems, products, processes, or services. As an example, the documents summarized within this section contain information on basic reliability and maintainability theory, methods of reliability data analysis and reliability prediction procedures. Design analysis checklists are also contained within some of the documents reviewed, with one document providing checklist information specific to the testability design of digital subassemblies and printed circuit boards (PCBs).

US Military R&M standards that fall under the category of design guide or handbook, but have not been reviewed as part of this effort are listed below. The current status of these documents under DoD Acquisition Reform can be found in Section 11, Chapter 2.

- MIL-HDBK-338 Electronic Reliability Design Handbook
- MIL-STD-454 Standard General Requirements for Electronic Equipment
- MIL-E-5400 General Specification for Aerospace Electronic Equipment

Chapter 1 IPC **D-330 2.3.4.1**
Reliability (Design Guide), 1982

Chapter 2 SAE **AE-9**
Automotive Electronics Reliability Handbook, February 1987

Chapter 3 SAE **ARD 50046**
Aerospace Resource Document: Reliability, Maintainability and Supportability Information Sourcebook, November, 1993

Chapter 4 SAE **M-102/95**
Reliability, Maintainability, and Supportability Guidebook, Second Edition; 1992

Chapter 5 CAN/CSA-**Q633**-90
Reliability, Availability, and Maintainability Design Guide for Electronic Products; May 1990

Chapter 6 NATO Standardization Agreement (STANAG) **4288** (Draft, Edition 1) Design Criteria To Facilitate Test Capability For NATO Communications And Associated Electronic Subassemblies In NATO Depots

Chapter 7 CAN/CSA-**Q636**-93
Guidelines and Requirements for Reliability Analysis Methods, June 1993

Chapter 8 DSTAN **00-5** (Part 1)/Issue 3 - Design Criteria for Reliability, Maintainability and Maintenance of Land Service Materiel: Part 1: General Requirements

Chapter 9 DSTAN **00-5** (Part 2)/Issue 3 - Design Criteria for Reliability, Maintainability and Maintenance of Land Service Materiel: Part 2: Mechanical Aspects

Chapter 10 DSTAN **00-5** (Part 3)/Issue 3 - Design Criteria for Reliability, Maintainability and Maintenance of Land Service Materiel: Part 3: Electrical and Electronic Aspects

Chapter 11 BS **5760**: Part 0: 1986 Reliability of Constructed or Manufactured Products, Systems, Equipments and Components, Part 0: Introductory Guide to Reliability

Chapter 12 BS **5760**: Part 3: 1982 Reliability of Systems, Equipments and Components, Part 3: Guide to Reliability Practices: Examples

Chapter 13 BSI Quality Management Handbook (QMH)

Chapter 14 **ARMP-2**, Edition No. 2: General Application Guidance on the Use of ARMP-1

Chapter 15 NASA NHB **5300-9** - Safety, Reliability and Quality Assurance Provisions for the Office of Aeronautics, Exploration and Technology Centers

CHAPTER 1: IPC D-330: SECTION 2.3.4.1 - RELIABILITY (DESIGN GUIDE)

This document is dated 1982 and contains 5 pages. Price: $400.00*

*This is the non-member price for the entire document (i.e., D-330). Only Section 2.3.4.1 of this document was reviewed. A copy of this section was obtained from the IHS CD-ROM library at the Reliability Analysis Center (RAC). IPC does not sell sections separately.

1.1 Outline of Document

1. Introduction

2. Failure Modes
   - 2.1 Extrinsic Failures
   - 2.2 Intrinsic Failure
     - 2.2.1 Premature
     - 2.2.2 Wearout

3. Factors Affecting Board Life
   - 3.1 Design Parameters
   - 3.2 Environmental Factors

4. Summary And Conclusions

1.2 Document Abstract

This document provides an overview of the types of failure that can occur for a printed wiring assembly. Failures are clearly categorized as either extrinsic (i.e., caused by random effects) or intrinsic (i.e., caused by inherent characteristics of the circuit).

1.3 Principal Features of the Document

Examples of both extrinsic and intrinsic failure causes and ways in which they can be prevented through design decisions is presented. Examples of wearout characteristics are also presented in addition to factors that affect board life. A brief description of design parameters that can be controlled and that enhance reliability is discussed. Examples of these parameters include wiring density and operating voltage.

1.4 Limitations/Tailoring Recommendations

No information is provided to determine how susceptible a particular board design is to either intrinsic or extrinsic failures. Also, while covering causes of failure and ways in which they may be prevented, no statistical data is provided on how often specific failure modes occur. Mention is made of the fact that such data exists, but references are not provided. Finally, while titled a reliability design guide, no examples of design practices are provided, nor are any references made to other documents that may provide such information.

It is recommend that this document be used as an introduction to printed wiring board (PWB) reliability, or as a reference to causes and potential solutions to PWB failure problems.

CHAPTER 2: SAE AE-9 - AUTOMOTIVE ELECTRONICS RELIABILITY HANDBOOK

This document is dated February 1987 and contains 482 pages. Price: $75.00

2.1 Outline of Document

1. Introduction

2. Reliability terminology associated with automotive electronics
   - 2.1 Definition
   - 2.2 Abbreviations and symbols

3. Reliability and Maintainability theory
   - 3.1 Introduction
   - 3.2 Reliability theory
   - 3.3 Temperature dependence of failure rate
   - 3.4 Statistical distributions used in reliability models
   - 3.5 Reliability modelling of simple structures
   - 3.6 Bayesian statistics in reliability analysis
   - 3.7 Availability theory
   - 3.9 R&M trade-off techniques

4. Reliability data analysis
   - 4.1 Introduction
   - 4.2 Preliminaries
   - 4.3 Statistical analysis
   - 4.4 Graphical methods
   - 4.5 Confidence limits and intervals
   - 4.6 Goodness of fit tests

5. Regression analysis for reliability modelling
   - 5.1 Introduction
   - 5.2 Graphical regression analysis
   - 5.3 Regression analysis and least squares theory

6. Reliability specification and allocation
   - 6.1 Introduction
   - 6.2 Reliability specification
   - 6.3 Reliability allocation
   - 6.4 Reliability program tasks
   - 6.5 Relative emphasis on reliability program elements

6-A Dynamic programming approach to reliability allocation

7. Reliability prediction
   - 7.1 Introduction and general information
   - 7.2 Similar equipment techniques
   - 7.3 Prediction by function technique
   - 7.4 Part count technique
   - 7.5 Stress analysis technique
   - 7.6 Prediction techniques for automotive applications
   - 7.7 Modification for non exponential failure densities
   - 7.8 Modification to include non operating failure rates
   - 7.9 Computerized reliability prediction methods
   - 7.10 Step by step procedure for performing reliability prediction and allocation
   - 7.11 The Delphi method

8. Reliability engineering design guidelines
   - 8.1 Introduction
   - 8.2 Part selection, control and derating
   - 8.3 Reliable circuit design
   - 8.4 Redundancy
   - 8.5 Environmental design
   - 8.6 Human factor
   - 8.7 Design reviews

9. FMECA, FTA and SCA
   - 9.1 Failure modes, effects and criticality analysis
   - 9.2 Fault tree analysis
   - 9.3 Sneak circuit analysis

10. Reliability demonstration and reliability growth testing
   - 10.1 Reliability demonstration
   - 10.2 Reliability growth

10-A Instruction on the use of reliability demonstration test plan

2.2 Document Abstract

This handbook was designed to provide the automotive electronics community with an understanding of the concepts, principles, and methodologies concerning all aspects of automotive electronic systems reliability engineering.

2.3 Principal Features of the Document

This handbook provides information pertaining to the automotive reliability discipline. The document is organized into ten chapters.

Chapters 1 and 2 are introductory in nature and define the applicable terms and acronyms.

Chapter 3 provides the theoretical and mathematical foundation for the reliability engineering discipline. Chapter 4 discusses the use of statistical goodness of fit tests, which aid the engineer in assessing how well a chosen distribution fits the data.

Chapter 5 discusses regression analysis, just one way of establishing a relation between a number of variables, one of which is dependent on the rest (i.e., failure rate is dependent on device style, ambient temperature, operating environment, duty cycle, etc.). A graphical approach to regression analysis is presented first as a concrete illustration of what is actually happening when a set of data points is fitted by a linear model. An introduction to regression analysis using the least squares approach is then presented. The methods presented are intended to provide a basic understanding of practical regression analysis.

Chapter 6 emphasizes the practical approaches to specifying and allocating equipment/system reliability. It discusses methods for specifying reliability quantitatively and describes procedures for allocating reliability to each of the elements of an equipment or system so as to meet the overall equipment/system reliability requirement.

Chapter 7 provides advice for performing a reliability prediction. This is the process of quantitatively assessing whether a proposed or actual design will meet a specified reliability requirement. Predictions do not in themselves, contribute significantly to system reliability. They do, however, constitute decision criteria for selecting courses of action which affect reliability. This chapter provides techniques and methods useful for performing reliability prediction and allocation.

Chapter 8 provides a family of design procedures available which the designer can use to achieve a desired reliability. It provides information on part selection, control, derating, reliable circuit design, redundancy, environmental and human factor design and design reviews. Each of the items above are briefly discussed in this section in terms of its role in the design of reliable equipment/systems. Chapter 9 discusses FMECA, FTA and SCA which are methods to analyze failures. Each method is

described with tailoring requirements. Finally, Chapter 10 provides information on reliability demonstration and reliability growth.

2.4 Limitations/Tailoring Recommendations

This handbook reflects, to a large extent, information gleaned from aerospace and defense specifications, standards, technology and practices, however, it is very wide in its application and usable by all industry and government sectors as well as academia. Even though the handbook is designed to provide the automotive electronics community with an understanding of reliability engineering as it applies to automotive electronics, its use is not limited to the automotive and allied industries since the underlying principles of reliability are the same.

CHAPTER 3: SAE ARD 50046 AEROSPACE RESOURCE DOCUMENT; RMS INFORMATION SOURCEBOOK

This document is dated November 1993 and contains 78 pages. Price: $50.00

3.1 Outline of Document

1. Introduction and usage

2. Organizations
   - 2.1 DoD Information Analysis Center
   - 2.2 Other Governmental Organizations
   - 2.3 DoD Agencies
   - 2.4 Professional Organizations
   - 2.5 Commercial Organizations
   - 2.6 Universities with a Reliability and Maintainability Curriculum

3. Publications
   - 3.1 Symposiums with published proceedings
   - 3.2 Technical Reports
   - 3.3 Periodic technical Journals
   - 3.4 Magazines and other periodic publications
   - 3.5 Reliability data publications
   - 3.6 Reliability and Maintainability Handbook
   - 3.7 Reliability textbooks
   - 3.8 Specifications and Standards

4. Databases
   - 4.1 Air Force databases
   - 4.2 Navy databases
   - 4.3 Army databases
   - 4.4 Marines Corps databases
   - 4.5 Other Government databases
   - 4.6 Lessons learned
   - 4.7 On-line search services

5. Electronic bulletin boards
   - 5.1 DoD bulletin boards

3.2 Document Abstract

This publication was developed to fill the need for a single, consolidated reference to the source of Reliability, Maintainability and Supportability (RMS) data and

information. This document consolidates information about all types of data sources - books, periodicals, organizations, on line databases, etc. - covering military industrial, commercial and professional societies.

3.3 Principal Features of the Document

This publication identifies sources which are readily available and helpful to the assurance technology practitioner. This document is organized into five chapters:

The introduction describes the purpose for the publication and the process by which information is kept current through periodic updates.

Chapter 2 provides information about government, military, professional, and educational organizations which support reliability and quality disciplines.

Chapter 3 deals with proceedings, journals, newsletters, periodicals, and books containing reliability data and information.

Chapter 4 provides information on automated and semi automated databases containing component and system reliability data.

Chapter 5 provides information on On-line resources for reliability information exchange.

3.4 Limitations/Tailoring Recommendations

The data sources listed cover a broad spectrum. Some focus on DoD needs, others serve a limited segment of the industrial community. Access to some data sources is restricted, while others are open to any and all users. Some sources are available at no cost to the user, where others will charge the user for their information. The document will tell you how to get the information you need.

Recently, there have been numerous changes within the DoD Some of these changes consist of the elimination/consolidation of DoD data systems. Some of the information regarding automated and semiautomated databases presented in Chapter 4 may be out of date.

CHAPTER 4: SAE M-102/95 - RELIABILITY, MAINTAINABILITY, AND SUPPORTABILITY GUIDEBOOK, SECOND EDITION

This document is dated 1992 and contains 528 pages. Price: $75.00

4.1 Outline of Document

1. Introduction
   - 1.1 Introduction to the Guidebook
   - 1.2 Guidebook Development
   - 1.3 Guidebook Objective
   - 1.4 Scope
   - 1.5 Guidebook Usage
   - 1.6 Procedure for Revision

2. Reliability, Maintainability and Supportability
   - 2.1 Introduction
   - 2.2 Elements of RMS
   - 2.3 RMS Program Planning and Implementation
   - 2.4 RMS Management and Control
   - 2.5 RMS in the System Design and Development Process
   - 2.6 RMS in the System Production Process
   - 2.7 RMS in the System Support Process
   - 2.8 RMS Education and Training
   - 2.9 RMS Task Descriptions

3. Reliability
   - 3.1 Introduction
   - 3.2 Statement and Definition of Reliability Requirements
   - 3.3 Reliability Program Planning and Implementation
   - 3.4 Reliability in the System Design and Development Process
   - 3.5 Reliability in the Production Process
   - 3.6 Reliability in the Support Process
   - 3.7 Reliability Task Descriptions

4. Maintainability
   - 4.1 Introduction
   - 4.2 Statement and Definition of Maintainability Requirements
   - 4.3 Maintainability Program Planning and Implementation
   - 4.4 Maintainability in System Design and Development
   - 4.5 Maintainability in the Production Process
   - 4.6 Maintainability in the Support Process
   - 4.7 Maintainability Task Descriptions

5. Supportability
    5.1 Introduction
    5.2 Supportability
    5.3 Supportability Program Planning and Implementation
    5.4 Supportability in System Design and Development
    5.5 Supportability in Production
    5.6 Supportability in the Support Process
    5.7 Supportability Task Descriptions

6. Life Cycle Cost
    6.1 Introduction
    6.2 Task Descriptions

7. Warranties
    7.1 Introduction
    7.2 Government Acquisition Sector
    7.3 Commercial Acquisition Sector
    7.4 Task Descriptions

8. RMS Information and Data Sources
    8.1 Introduction
    8.2 List of Sources
    8.3 Task Description Guidance (Subsection 8) Classification and Sources
    8.4 Task Description References/Supplemental Guidance (Subsection 9) Classification and Sources

Appendix A   Task Description Development
Appendix B   List of Contributors

4.2 Document Abstract

This guidebook provides a "desk reference" stand-alone source of general information and standardized descriptions of tasks, and establishes a forum for identification and distribution of current and emerging technologies and guidance. It is not intended to be a "how to" document, but rather a road map to sources of "how to" information. It is designed for use by RMS engineers, analysts, designers, and program managers. The guidebook should be especially useful to individuals needing a refresher course in RMS or beginning a new assignment.

4.3 Principal Features of the Document

The introduction provides guidebook development background, objective, scope, usage and procedure for revision. Chapter 2 provides an overview of RMS, with the emphasis being on integration of RMS into the design, manufacturing and support processes. Reliability, maintainability, supportability, life cycle cost and warranties task descriptions are contained in Chapters 3, 4, 5, 6 and 7, respectively. Chapter 8 provides RMS information and data sources.

4.4 Limitations/Tailoring Recommendations

The guidebook reflects, to a large extent, aerospace and defense specifications, standards, technology and practices, however, it is very wide in its application and usable by all industry and government sectors as well as academia. Its use is not limited to the automotive and allied industries.

CHAPTER 5: CAN/CSA-Q633-90 - RELIABILITY, AVAILABILITY, AND MAINTAINABILITY DESIGN GUIDE FOR ELECTRONIC PRODUCTS

This document is dated May, 1990 and contains 33 pages. Price: $70.00

5.1 Outline of Document[1]

Preface

1. Scope

2. Definitions

3. RAM Design Requirements
   - 3.1 General
   - 3.2 Development Process
   - 3.3 RAM Process
     - 3.3.1 General
     - 3.3.2 Concept Evaluation
     - 3.3.3 Design Analysis
     - 3.3.4 Product Verification
     - 3.3.5 Design Transfer

Appendices
- A - Concept Evaluation Checklist
- B - Design Analysis Checklist
- C - Product Verification Checklist
- D - Design Transfer Checklist

5.2 Document Abstract

This standard was developed to assist electronic product manufacturers. It provides an integrated RAM design approach in product development that will meet the needs of the product users in a highly competitive electronics world market. The standard is designed to bridge the gap between RAM principles and practical applications. This standard is so structured with simple, practical, and pertinent design checks during key design process steps to gain meaningful information in determining the viability of the product design.

5.3 Principal Features of the Document

The standard outlines four major product development stages as Definition, Design, Verification and Manufacture & Introduction while clearly showing major design review points and the parallel RAM processes that go on during each of the four stages. For each development stage, the standard outlines both the major design processes and the major RAM processes involved. For each development stage, major inputs and outputs are outlined. Each RAM process has an Appendix associated with it that provides a check list of activities to be considered by the RAM specialist, in the form of questions. These questions are a comprehensive list of issues that need to be addressed at each stage of product development. For the Design Stage, the RAM checklist provides general and specific questions related to the use of the following part types: capacitors, resistors, transistors, diodes, integrated circuits and other miscellaneous parts. Thermal considerations and electromagnetic compatibility issues are also addressed.

5.4 Limitations/Tailoring Recommendations

While this is listed as a RAM design guide, heavy emphasis is put on reliability, especially in the product phase checklists found in the appendices. It is not recommended as a maintainability design guide. The guideline is organized in a fashion that makes this an easy to tailor document in that the checklists found in the appendices are in the form of questions, rather than specific tasks. Therefore, the user need only address those questions that are relevant to the particular design being considered.

CHAPTER 6: NATO STANDARDIZATION AGREEMENT (STANAG) 4288 (DRAFT, EDITION 1) DESIGN CRITERIA TO FACILITATE TEST CAPABILITY FOR NATO COMMUNICATIONS AND ASSOCIATED ELECTRONIC SUBASSEMBLIES IN NATO DEPOTS

This document is dated: None listed, and contains 15 pages. Price: $26.00

6.1 Outline of Document

Explanatory Notes
- Agreement
- Definitions
- Ratification, Implementations and Reservations

Aim
Agreement
Definitions
Details Of The Agreement
Implementation Of The Agreement
Annexes:
- A Criteria for Functional ATE Method
- B Criteria for In-Circuit ATE Method
- C Existing Testers in NATO Depots
- D Minimum Quality Requirements for Test Software
- E Reference Documents (for information)

6.2 Document Abstract

The intent of this document is to provide criteria relating to the design of electronic sub-assemblies and printed circuit boards (PCBs) to facilitate their testing in NATO depots on specific Automatic Test Equipment (ATE) designed for digital technology and on specific in-circuit testers.

6.3 Principal Features of the Document

This document provides testability design guidelines for digital sub-assemblies and PCBs that will enhance the test effectiveness and ability to test such systems on ATE. This information is provided in Annexes A and B of the document. The guidelines are currently presented as requirements, and are specific to digital designs. Most of the testability guidelines represent hardware design approaches that increase sub-assembly testability, such as the ability to tri-state logic devices connected to a bus

and providing external controllability to internal clock circuitry. Guidance is also given on test software development to increase fault detection capability. Specifically, four fault classes, (Stuck high/low on all externals, Stuck high and low on all device inputs and outputs) are defined for simulation verification. Other test requirements to be implemented in the test software are also defined, as they relate to digital designs. In addition to digital designs, guidance is provided for other technologies, including digital, to be tested using in-circuit testers. This guidance includes definition of documentation packages to be delivered with test programs, such as delivery of component drawings and layout, parts list, sub-assembly or PCB functional descriptions, and manufacturer's recommended test patterns for LSI/VLSI devices.

6.4 Limitations/Tailoring Recommendations

The major limitation to this document is that ANNEX D, which defines minimum quality requirements for test software, is specific to two GenRad Corporation testers that are obsolete. Despite this drawback, the information contained in this document is useful as a testability design guide and test program development guide for today's digital and non-digital systems. The document could serve as a template for developing an in-house guideline on testability practices and test program support documentation development.

CHAPTER 7: CAN/CSA-Q636-93 - GUIDELINES AND REQUIREMENTS FOR RELIABILITY ANALYSIS METHODS; JUNE 1993

This document is dated June, 1993 and contains 59 pages. Price: $79.50

7.1 Outline of Document[1]

Preface

1. Scope

2. Reference Publication

3. Definitions

4. Reliability Analysis Concepts
   - 4.1 General
   - 4.2 Analysis Approach
   - 4.3 Role of Reliability Analysis

5. Reliability Analysis Methods
   - 5.1 Prerequisites for a Reliability Analysis
   - 5.2 Reliability Analysis Documentation

6. Reliability Analysis Methods
   - 6.1 General
   - 6.2 Selection of Reliability Analysis Methods
     - 6.2.1 General
     - 6.2.2 Fault Tree Analysis
     - 6.2.3 Reliability Block Diagram Method
     - 6.2.4 Markov Analysis Methods
     - 6.2.5 Failure Modes and Effects Analysis (FMEA)
     - 6.2.6 Parts Count Method
     - 6.2.7 Stress Analysis Methods

Appendices
- A Fault Tree Analysis
- B Reliability Block Diagram Method
- C Markov Analysis
- D Failure Mode and Effects Analysis
- E Parts Count Method
- F Part Stress Analysis Method
- G Bibliography

7.2 Document Abstract

This Standard provides guidance to managers and engineers for the selection and application of reliability analysis methods. Its purpose is to describe some of the reliability analysis methods which are most commonly used and are representative of international standard methods, to provide guidance for the selection of analysis methods depending on technology and application of the system or product being analyzed, and to give requirements for the documentation of results obtained through reliability analysis.

7.3 Principal Features of the Document

This document clearly outlines the purpose of a reliability analysis and explains both qualitative and quantitative methods. Reliability analysis requirements, in terms of prerequisite knowledge is outlined. The standard also devotes an entire subsection to the proper ways in which a reliability analysis needs to be documented. Guidance here is given on how to organize the report, what kinds of information to include, including drawings, figures, tables, analysis approaches, assumptions and reliability data sources. The six different reliability analysis methods listed in Section 6 of the document outline herein are explained in terms of purpose and when each method is suitable to use. More detailed information on each method is provided in the appendices, including short examples to illustrate each method.

7.4 Limitations/Tailoring Recommendations

An overall good reference document for reliability managers and engineers. The Standard is designed to be a guidance document, and therefore tailoring is not applicable. While the document can be used to help determine how to select a particular reliability analysis method, the appendices should only be used as an introduction to each method described. More detailed references should be used to become proficient in each method.

CHAPTER 8: DSTAN 00-5 (PART 1)/ISSUE 3 - DESIGN CRITERIA FOR RELIABILITY, MAINTAINABILITY AND MAINTENANCE OF LAND SERVICE MATERIEL: PART 1: GENERAL REQUIREMENTS

This document is dated 2 February, 1979, and contains 36 pages. Price: $44.50

8.1 Document Outline*

1. Contents and Index
2. Definitions
3. Statement of General Policy
4. General Reliability, Maintainability and Maintenance Requirements
5. Reliability and Maintainability Plans and Programmes
6. Safety Requirements

Annex A. Related Documents
Annex B. NATO STANAGS 2816 and 2817 - Substance of Agreement

8.2 Document Abstract

This standard provides general and some specific guidance on the development of requirements as they relate to reliability and maintainability management, system design features for ease of maintenance, and safety of personnel and materials. Despite the age of the document, most, if not all, of the material presented remains applicable to systems being developed today. Wording is provided that makes this standard a tailorable document within any procurement structure.

8.3 Principal Features of the Document

The primary part of this document concentrates on providing guidance on requirements for the design of equipment for the purpose of making such equipment easy to maintain. The standard is somewhat unique in that it requires the maintenance authority, or any organization that is to be responsible for maintaining the system or equipment, to play an important role in defining reliability, maintainability and maintenance features and requirements. The areas discussed concerning design for ease of maintenance include a list of basic factors to be optimized (e.g., alignment and/or setting-up skill, diagnostic time, durability, ease of inspection in storage,

standardization of parts, tools: quantity, variety, complexity, cost), standardization and interchangeability, environmental considerations (as they affect maintenance), accessibility, testing, (equipment and requirements), identification, handling, stowage and storage, and prevention of misuse.

One particular clause is entitled "Rights of Access by the Maintenance Authority," which provides for the maintenance authority to have access to the contractor and co-locate a maintenance advisory person with the contractor, when and if required. The maintenance authority will be involved in the interpretation of reliability, maintainability and maintenance requirements, development of maintenance policies, consideration of design alternative in relationship to the associated maintenance requirements and developed maintenance plan, determination of in-service test procedures, organization of ease of maintenance trials, obtaining all the maintenance information to enable the necessary technical publications to be written and/or vetted, and obtaining reliability and maintainability data for assessment purposes.

The remainder of the standard lists basic requirements for a reliability and maintainability program plan and lists basic tasking found in other such standards. A section is also devoted to safety, including safety to maintenance personnel and safety of materials.

8.4 Limitations/Tailoring Recommendations

As stated in the abstract above, this document is applicable to any kind of system being procured today. It is most applicable to defining design requirements as they affect ease of maintenance, although reliability and maintainability program planning is covered. Wording up front in this standard advises that the whole text is not intended to be applied in all cases. In fact, in step with many of the procurement philosophies within the US DoD, this standard states that in the case of procurements of commercial material, the standard may be used as a guide against which contending equipments may be assessed, without complete compliance being required. Furthermore, paragraph 1.3.2.h of the standard states the following, "When the service requirement can be met by the purchase of commercial materiel, mandatory conformance to the requirements of this Standard will normally not be required; these requirements, however, will be applied by the procurement authorities in the evaluation of such materiel." Therefore, the wording is such that tailoring is encouraged and guidance for such tailoring is provided.

CHAPTER 9: DSTAN 00-5 (PART 2)/ISSUE 3 - DESIGN CRITERIA FOR RELIABILITY, MAINTAINABILITY AND MAINTENANCE OF LAND SERVICE MATERIEL: PART 2: MECHANICAL ASPECTS

This document is dated 16 February, 1979, and contains 33 pages. Price: $43.00

9.1 Document Outline*

1. Contents and Index
2. General Maintainability Requirements
   - 2.1 Environmental considerations
   - 2.2 Repair and Fabrication of materials in the field
   - 2.3 Provision of adjustment
   - 2.4 Water crossing hazards
   - 2.5 Recovery and towing
   - 2.6 Screw threads
   - 2.7 Bolts, nuts, studs, and screws
   - 2.8 Rolling bearings subjected to heavy loading
3. Detailed Maintainability Requirements
   - 3.1 General
   - 3.2 Fuels and lubricants
   - 3.3 Bearings and lubrication
   - 3.4 Oil, fuel, and water tanks
   - 3.5 Drainage
   - 3.6 Component marking
   - 3.7 Splined shafts
   - 3.8 Chain drives
   - 3.9 Pipe and hose connections
   - 3.10 Pipelines and piping
   - 3.11 Bodywork
   - 3.12 Chassis
   - 3.13 Recorders
   - 3.14 Engine adjustments
4. Internal Combustion Engines
   - 4.1 Cylinders
   - 4.2 Air cleaners
   - 4.3 Radiators and cooling systems
   - 4.4 Drive belts
   - 4.5 Engine timing
   - 4.6 Exhaust systems
   - 4.7 Ignition systems
   - 4.8 Cold starting aids
5. Fuel Systems
   - 5.1 Fuel filters
   - 5.2 Fuel lift pumps
   - 5.3 Fuel lines
   - 5.4 Fuel tank filler caps
   - 5.5 Fuel cocks
   - 5.6 Injectors and injection pumps
   - 5.7 Bleeding of fuel injection systems
   - 5.8 Drainage of fuel systems
   - 5.9 Starting chokes and excess fuel devices
   - 5.10 Fuel gauge transmitter units
6. Transmissions, Drives and Suspensions
   - 6.1 Torsion bars
   - 6.2 Shock absorbers
   - 6.3 Wheels
   - 6.4 Wheel hubs
   - 6.5 Brakes
   - 6.6 Clutches
   - 6.7 Drive shafts
   - 6.8 Tyres
   - 6.9 Tracks

9.2 Document Abstract

This standard concentrates on providing reliability and maintainability requirements guidance for the design of mechanical land service vehicles and materials.

9.3 Principal Features of the Document

This standard contains guidance on the design of mechanical items for reliability and maintainability. A great deal of emphasis is put on standardization of parts, fuels and lubricants, accessibility, ease of removal and replacement, and use of long lasting materials and self lubricating components. The ease of condition monitoring is also stressed. For example, where daily checking of fluid is required, the standard requires that all such levels should be capable of being completed, without the use of hand tools, and by one man within five minutes. In addition to mechanical systems, one section

(10) is devoted to mechanical systems test equipment. This section covers climatic protection and structural design (materials, wheels, towing and transportation).

Much of the language is qualitative in nature, but could easily be used to develop an in-house design guide for mechanical systems.

9.4 Limitations/Tailoring Recommendations

This document is applicable to any kind of mechanical system being procured today. It is most applicable to defining design requirements as they affect ease of maintenance and reliability and maintainability. Wording up front in this standard advises that the whole text is not intended to be applied in all cases. In fact, in step with many of the procurement philosophies within the US DoD, this standard states that in the case of procurements of commercial material, the standard may be used as a guide against which contending equipments may be assessed, without complete compliance being required. Therefore, the wording is such that tailoring is encouraged and guidance for such tailoring is provided.

CHAPTER 10: DSTAN 00-5 (PART 3)/ISSUE 3 - DESIGN CRITERIA FOR RELIABILITY, MAINTAINABILITY AND MAINTENANCE OF LAND SERVICE MATERIEL: PART 3: ELECTRICAL AND ELECTRONIC ASPECTS

This document is dated 16 February, 1979, and contains 27 pages. Price: $39.50

10.1 Document Outline*

1. Contents and Index
2. Reliability, Maintainability And Maintenance Requirements

2.1 Environmental considerations

2.2 Circuit Design And Equipment Configuration

- a. General
- b. Assemblies, sub-assemblies and modules
- c. Interconnections
- d. Controls
- e. Electrical equipment
- f. Electronic equipment

2.3 Panel, Electronic Circuit (PEC)

2.4 Cables, Wiring and Waveguides

2.5 Connectors and Terminals

2.6 Solder

2.7 Connections

2.8 Components

- a. General
- b. Active devices

2.9 Identification

2.10 Insulating materials

2.11 Safety And Protection

- a. Hazards to personnel
- b Hazards to equipment
- c. Equipment design
- d. Earthing

2.12 Testing Materiel In Service

2.13 Testing Requirements

- a. General
- b. Alignment
- c. Signal and waveform test points
- d. Voltage and current test points
- e. Elector-mechanical systems

2.14 Test Equipment

2.15 Electrical Rotating Machinery

10.2 Document Abstract

This standard concentrates on providing design guidance for electrical and electronic items used in land surface material as it affects item reliability and maintainability. It is Part 3 in a four part series. The four Parts of DSTAN 00-5 are: Part 1: General Requirements, Part 2: Mechanical Aspects, Part 3: Electrical and Electronic Aspects, and Part 4: Optical Aspects.

10.3 Principal Features of the Document

This standard contains guidance on the design of electrical and electronic items for reliability and maintainability. As reflected in the above Document Outline section, the information covers a number of different subjects and is presented in almost a checklist format. The design guidance provided is in the form of sentences that are relevant to the subject area. For example, within Section 2.4, Cables, Wiring and Waveguides, 20 subsections are provided. Subsection c. of Section 2.4 states that "To minimize flexure under shock and vibration, wires and/or cables shall be made up into wiring harnesses. Sufficient slack shall be left to prevent unacceptable tension at terminations and to allow re-termination." Similar styles of statements are provided within each section.

In addition to providing design guidance for specific types of electrical and electronic items, other sections are devoted to safety (of personnel and materials), testing requirements, test equipment, electrical rotating machinery, electromagnetic compatibility, voltage supplies and batteries, drying and sealing and elapsed time indicators. The section on safety is quite extensive and provides design guidance to avoid hazards to the equipment.

Much of the language is qualitative in nature, but could easily be used to develop an in-house design guide for electrical and electronic systems, including safety design guidance and test equipment.

10.4 Limitations/Tailoring Recommendations

While this document is aimed at electrical and electronic items used in land service materiel, much of the information could be tailored and adapted for other applications as well. It is most applicable to defining design requirements as they affect ease of maintenance and reliability and maintainability. Wording up front in this standard advises that the whole text is not intended to be applied in all cases. In fact, in step with many of the procurement philosophies within the US DoD, this standard states that in the case of procurements of commercial material, the standard may be used as a guide against which contending equipments may be assessed, without complete compliance being required. Therefore, the wording is such that tailoring is encouraged and guidance for such tailoring is provided.

CHAPTER 11: BS 5760: PART 0: 1986 RELIABILITY OF CONSTRUCTED OR MANUFACTURED PRODUCTS, SYSTEMS, EQUIPMENTS AND COMPONENTS, PART 0: INTRODUCTORY GUIDE TO RELIABILITY

This document is dated 1986, and contains 12 pages. Price: $76.00

11.1 Document Outline

Foreword
Committees responsible
0 Introduction
1 Scope
2 Definitions
3 What is reliability?
4 The cost aspect of reliability
5 Business organization for reliability
   5.1 Management
   5.2 Revolutionary and evolutionary designs
   5.3 Reliability, performance, maintenance and environment
6. The application of reliability principles
7. Being objective about reliability
   7.1 Introduction
   7.2 Why do things fail?
   7.3 Reliability measures
   7.4 How the failure rate can change (bath tub curve)
   7.5 The numbers game
   7.6 Effect of maintenance on down time and costs
   7.7 Human factors
8. System considerations
   8.1 System reliability (durability)
   8.2 System maintainability
   8.3 System availability
   8.4 Software reliability
9. Conclusion

11.2 Document Abstract

This document is the first in a current total of 15 parts related to the reliability and maintainability of constructed or manufactured products. This part is aimed at directors, novice reliability engineers, and at middle management and marketing individuals not trained in engineering. The basic advantages of producing a reliable product to company reputation and market share are discussed.

11.3 Principal Features of the Document

This document introduces the concepts and definitions of reliability, maintainability and availability and stresses the importance of these features to the success of a product within its specific marketplace. The material is more of a qualitative presentation on reliability and makes use of tables and charts to show the tradeoff of cost versus added reliability, and cost versus added maintainability. Other parts discuss the role that reliability should play in the overall management structure of a company. Specifically, this document shows that reliability should be equal in importance to other factors, such as performance, and to be effective, requires management support at the highest levels. Concepts of failures, and what causes them to occur are introduced and discussed. Overall, this document serves as a good introduction to reliability, and provides information relating the effects of reliability to overall cost to manufacture and maintain. In essence, the discussion is put into terms that are more likely to be understood by managers who do not specialize in engineering, but need to be concerned about product reputation and market longevity.

11.4 Limitations/Tailoring Recommendations

Only basic qualitative information is provided in this standard. The mathematical principles and techniques for reliability, and maintainability, are provided in other parts of the BS 5760 series of standards. This document is not meant to be tailored nor applied to any specific program. Rather, it is strictly an introductory guide to directors, managers, and novice reliability engineers.

CHAPTER 12: BS 5760: PART 3: 1982 RELIABILITY OF SYSTEMS, EQUIPMENTS AND COMPONENTS, PART 3: GUIDE TO RELIABILITY PRACTICES: EXAMPLES

This document is dated 1982, and contains 80 pages. Price: $200.50

12.1 Document Outline

Section Five. Function and Maintenance Phase

21. Example of the application of Pareto's principle to failure data on domestic washing machines
22. Example of the Weibull analysis of machine failure data using alternative methods
23. Example of the Weibull analysis of wear in a reciprocating compressor used in the food industry
24. Example of the collection of reliability data and the prediction of reliability of scientific instruments
25. Example of reliability analysis in the maintenance of paper-making machinery
26. Example of the distribution of tool replacement times of multi-tool machines

Appendix

A. Examples of the use of basic mathematical techniques

12.2 Document Abstract

This document is the fourth in a current total of 15 parts related to the reliability and maintainability of systems, equipments and components. This Part is aimed at providing brief examples to illustrate the assessment, analysis, and management techniques and processes that are provided in Parts 1 and 2 of the series, respectively. BS 5760: Part 1 is a guide to reliability and maintainability programme management, and Part 2 is a guide to the assessment of reliability.

12.3 Principal Features of the Document

The examples provided are taken from actual programs, where the names of particular organizations are omitted. The examples are arranged by equipment life cycle phases as illustrated in the above outline. Where relevant, references to particular paragraphs or sections of BS 5760 Parts 1 or 2 are made within each particular example.

The examples provided are summary in nature and attempt to present key points or key reasons as to the purpose of the illustrated technique, without presenting specific details of how the example results are obtained. Several reference documents are cited in Section 1 of the document and are referred to throughout for further details. A wide variety of examples using systems and equipments from a variety of industries, including automotive, military, chemical and energy are presented.

12.4 Limitations/Tailoring recommendations

Many of the examples presented require background knowledge in the statistical or reliability assessment methodologies referred to. Without such knowledge, the examples would be difficult to understand. However, in many cases, the benefits of applying a specific technique are discussed, making such information useful to managers and novice reliability engineers alike. The examples presented are best used in conjunction with Parts 1 and 2 of BS 5760, or within a reliability training course that covers in greater detail specific mathematical techniques and reliability assessment methods. In this light, the examples could be presented as student problems after covering a specific topic.

CHAPTER 13: BSI QUALITY MANAGEMENT HANDBOOK (QMH)

This document is dated 1995 and contains 1,524 pages in three volumes. Price: $605.00

The BSI QMH is a three volume set of BSI standards and guidelines. Each volume is a compendium or collection of several standards, all of which are available individually from BSI. The following tables list the standards within each volume with a short description that is based on the executive summary found within each volume. In some cases, the individual standards were purchased separately and reviewed elsewhere in this document. In reviewing some of the individual standards, it appears that the copies of these standards found in the QMH contain less information. However, this has not been confirmed in all cases. It can be noted that the cost of the three volume set is less than the total cost of purchasing each of the standards separately.

TABLE 3-1: BSI STANDARDS CONTAINED IN BSI QMH PART 1: QUALITY ASSURANCE

Document Title	Description	Notes
BS 4778: Part 1: 1987 Quality Vocabulary: International Terms	Twenty-two basic terms are defined in three different languages: English, French and Russian.	Identical with ISO 8402, 1986 & EN 28402, 1991
BS 4778: Part 2: 1991 Quality Vocabulary: Quality concepts and related definitions	Definitions of terms and concepts are divided into five sections: Quality, Management, Control, General Inspection and Statistical Inspection. Some terms are also covered in Part 1.	
BS 5233: 1986 Glossary of terms used in metrology (incorporating BS 2643	Metrology is important to the quality of manufactured goods. This standard covers terms that have been selected from BSI PD 6461: Part 1 : 1985 which provides basic and general terms in metrology.	
BS EN ISO 9000-1: 1994 Quality management and quality assurance standards: Guidelines for selection and use	Provides a roadmap into the use of all ISO 9000 series of quality standards. Five annexes provide terms and definitions, product and process factors, proliferation of standards, cross-reference lists of clause numbers for corresponding topics, and a bibliography.	Formerly BS 5750 : Section 0.1
BS EN ISO 9001: 1994 Quality systems: Model for quality assurance in design, development, production, installation and servicing	One of three quality assurance models that can be used for the purpose of a supplier demonstrating its capability and for the assessment of such by external parties. Each model is generic and independent of any specific industry or product.	Formerly BS 5750: Part 1
BS EN ISO 9002: 1994 Quality systems: Model for quality assurance in production, installation and servicing	One of three quality assurance models that can be used for the purpose of a supplier demonstrating its capability and for the assessment of such by external parties. Each model is generic and independent of any specific industry or product.	Formerly BS 5750: Part 2

TABLE 3-1: BSI STANDARDS CONTAINED IN BSI QMH PART 1: QUALITY ASSURANCE (CONT'D)

Document Title	Description	Notes
BS EN ISO 9003: 1994 Quality systems: Model for quality assurance in final inspection and test	One of three quality assurance models that can be used for the purpose of a supplier demonstrating its capability and for the assessment of such by external parties. Each model is generic and independent of any specific industry or product.	Formerly BS 5750: Part 3
BS EN ISO 9004-1: 1994 Quality management and quality system elements: Guidelines	Provides information and insight into the basics of all quality systems and general quality management.	Formerly BS 5750: Section 0.2
BS 5750: Part 4: 1994 Quality Systems: Guide to the use of BS EN ISO 9001 'Model for quality assurance in design, development , production, installation and servicing (Formerly BS 5750: Part 1)', BS EN ISO 9002 'Model for quality assurance in production, installation and servicing (Formerly BS 5750: Part 2)' and BS EN ISO 9003 'Model for quality assurance in final inspection and test (Formerly BS 5750: Part 3)	Highlights important aspects of ISO 9001, 9002 and 9003 which require attention. The intended use is to give guidance to organizations that wish to ensure they comply with the requirements of the aforementioned standards.	
BS 5750: Part 8: 1991 Quality systems: Guide to quality management and quality management and quality systems elements for services	The guidance provided is concerned more with the delivery of services rather than the supply of products. The standard stresses successful application of quality management principles to services providing opportunities for improved service performance and customer satisfaction, improved productivity, efficiency and cost reduction, and improved market share.	Identical with ISO 9004-2: 1981
BS 5750: Part 13: 1991 Quality Systems: Guide to the application of BS 5750: Part 1 to the development, supply and maintenance of software	Provides guidance for software quality assurance and for establishing a quality management system. Applicable mainly to software developed under contract to specified requirements.	Identical with ISO 9000-3: 1991
BS 5750: Part 14: 1993 Quality Systems: Guide to dependability programme management	Guidance provided is applicable to hardware and software where dependability characteristics are significant during the operation and maintenance phase. For a detailed review, see Section 9, Chapter 1.	Identical with EN 60300-1, ISO 9000-4 and IEC 300-1, 1993
BS 5760: Part 0: 1986 Reliability of systems, equipment and components: Introductory guide to reliability	Document is aimed specifically at non-specialists in the field of reliability but who need to be aware of the impact and importance of this characteristic on product effectiveness, profitability and market share. For a detailed review, see Section 3, Chapter 11.	Also contained in Part 2: Volume I: Reliability and reviewed in Section 3 of this document

TABLE 3-1: BSI STANDARDS CONTAINED IN BSI QMH PART 1: QUALITY ASSURANCE (CONT'D)

Document Title	Description	Notes
BS 6143: Part 1: 1992 Guide to the economics of quality: Process cost model	The methods presented rely on the use of process modelling as applied to the quality costs of any process or service. The cost of conformance and non-conformance are presented.	
BS 6143: Part 2: 1990 Guide to the economics of quality: Prevention, appraisal and failure model	This document presents a revised version of the traditional method of production quality costing in manufacturing industries.	
BS 7000: Part 1: 1989 Design management systems: Guide to managing product design	Three levels of organization structure are addressed as they relate to the management of product design: senior management, project managers, design managers and designers. An outline of an efficient level of current practice that companies should aim to achieve is presented.	
BS 7000: Part 3: 1994 Design management systems: Guide to managing service design	Guidance is given on the management of design of service at all levels, for all design organizations and all types of service.	
BS 7000: Part 10: 1994 Design management systems: Glossary of terms used in design management	This document was prepared to act as a guide to the use and application of other parts of BSI 7000 and for those interested in design and its management.	
BS 7373: 1991 Guide to the preparation of specifications	Guidance is given on the overall management considerations related to specification generation such as projecting the company's image, its rights to data and protection from liability. Other topics covered include the layout preparation and management of specifications. Guidance provided is applicable to preparing user manuals or leaflets accompanying products in all sectors of the market.	
BS 7850: Part 1: 1992 Total quality management: Guide to management principles	Guidance provided is targeted to senior management. Emphasis is put on the recognition that customer satisfaction, health and safety, the environment and business objectives are mutually dependent and that all business can be broken down into a series of process steps.	
BS 7850: Part 2: 1994 Total quality management: Guidelines for quality improvement	Provides guidance on the implementation of a continuous quality improvement process, as applied to every aspect of the organization. An informative list of TQM tools and techniques is also provided.	Identical with ISO-9004 Part 4: 1993
BS EN 30011: Part 1: 1993 Guidelines for auditing quality systems: Auditing	Information on developing a quality audit system is presented in a general fashion that makes it applicable or adaptable to different industries and organizations.	Identical with ISO 10011-1: 1990 and formerly BS 7229: Part 1

TABLE 3-1: BSI STANDARDS CONTAINED IN BSI QMH PART 1: QUALITY ASSURANCE (CONT'D)

Document Title	Description	Notes
BS EN 30011: Part 2: 1993 Guidelines for auditing quality systems: Qualification criteria for quality systems auditors	Provides information on the qualifications needed in quality auditors and is applicable to those organizations who must choose such individuals. Annex A provides a method to judge individual potential auditors' compliance to the selection criteria.	Identical with ISO 10011-2: 1991 and formerly BS 7229: Part 2
BS EN 30011: Part 3: 1993 Guidelines for auditing quality systems: Management of audit programmes	Focuses on the management of an audit giving basic guidelines for managing quality system audit programs as carried out in accordance with Part 1 of the series.	Identical with ISO 10011-3: 1991 and formerly BS 7229
BS EN 30012: Part 1: 1993 Quality assurance requirements for measuring equipment: Metrological confirmation system for measuring equipment	Applicable to measurement equipment used in the demonstration of compliance with a specification only. Specifically, the information provided is applicable to testing laboratories, suppliers of product or services who operate a quality system, and to other organizations where measurement is used to show compliance with requirements.	Identical with ISO 10012-1: 1982
PD 6538: 1993 Vision 2000: A strategy for international standards' implementation in the quality area during the 1990s	Presentation is outlined in four major sections: The Stake; Basic Concepts; Analysis of the Market Place; and Vision 2000. Recommendations are provided on the implementation of the BS EN ISO 9000 series of standards.	Identical to the ISO publication having the same title

TABLE 3-2: BSI STANDARDS CONTAINED IN BSI QMH PART 2: RELIABILITY

Document Title	Description	Notes
BS 5760: Part 0: 1986 Reliability of systems, equipment and components: Introductory guide to reliability	Reviewed in Section 3, Chapter 11 of this document.	
BS 5760: Part 1: 1985 Reliability of systems, equipment and components: Guide to reliability and maintainability programme management	Reviewed in Section 9, Chapter 8 of this document.	
BS 5760: Part 2: 1994 Reliability of systems, equipment and components: Guide to the assessment of reliability	Reviewed in Section 4, Chapter 10 of this document.	
BS 5760: Part 3: 1982 Reliability of systems, equipment and components: Guide to reliability practices: examples	Reviewed in Section 3, Chapter 12 of this document.	

TABLE 3-2: BSI STANDARDS CONTAINED IN BSI QMH PART 2: RELIABILITY (CONT'D)

Document Title	Description	Notes
BS 5760: Part 4: 1986 Reliability of systems, equipment and components: Guide to specification clauses relating to the achievement and development of reliability in new and existing items	Reviewed in Section 10, Chapter 7 of this document.	
BS 5760: Part 5: 1991 Reliability of systems, equipment and components: Guide to failure modes, effects and criticality analysis (FMEA and FMECA)	Reviewed in Section 4, Chapter 11 of this document.	
BS 5760: Part 6: 1991 Reliability of systems, equipment and components: Guide to programme for reliability growth	Reviewed in Section 9, Chapter 2 of this document.	Identical to IEC 1014: 1989
BS 5760: Part 7: 1991 Reliability of systems, equipment and components: Guide to fault tree analysis	Reviewed in Section 4, Chapter 4 of this document.	Identical to IEC 1025: 1990
BS 5760: Part 9: 1992 Reliability of systems, equipment and components: Guide to the block diagram technique	Reviewed in Section 4, Chapter 5 of this document.	Identical to IEC 1078: 1991
BS 5760: Section 10.1: 1993 Reliability of systems, equipment and components: Guide to reliability testing: General requirements	Reviewed in Section 5, Chapter 1 of this document.	Identical to IEC 605-1: 1978
BS 5760: Section 10.2: 1993 Reliability of systems, equipment and components: Guide to reliability testing: Design of test cycles	Reviewed in Section 5, Chapter 2 of this document.	Identical to IEC 605-2: 1994
BS 5760: Section 10.3: 1993 Reliability of systems, equipment and components: Guide to reliability testing: Compliance test procedures for steady-state availability	Reviewed in Section 5, Chapter 10 of this document.	Identical to IEC 1070: 1991
BS 5760: Section 10.5: 1993 Reliability of systems, equipment and components: Guide to reliability testing: Compliance test plans for success ratio	Reviewed in Section 5, Chapter 11 of this document.	Identical to IEC 1123: 1991

TABLE 3-2: BSI STANDARDS CONTAINED IN BSI QMH PART 2: RELIABILITY (CONT'D)

Document Title	Description	Notes
BS 5760: Part 11: 1994 Reliability of systems, equipment and components: Collection of reliability, availability, maintainability and maintenance support data from the field	Reviewed in Section 7, Chapter 1 of this document.	Identical to IEC 300-3-2: 1993
BS 5760: Part 12: 1993 Reliability of systems, equipment and components: Guide to the presentation of reliability, maintainability and availability predictions	Reviewed in Section 4, Chapter 3 of this document.	Identical to IEC 863: 1986
BS 5760: Section 13.1: 1993 Reliability of systems, equipment and components: Guide to reliability test conditions for consumer equipment: Conditions providing a low degree of simulation for indoor portable equipment	Reviewed in Section 5, Chapter 3 of this document.	Identical to IEC 605-3-1: 1986
BS 5760: Section 13.2: 1993 Reliability of systems, equipment and components: Guide to reliability test conditions for consumer equipment: Conditions providing a high degree of simulation for equipment for stationary use in weatherprotected locations	Reviewed in Section 5, Chapter 4 of this document.	Identical to IEC 605-3-2: 1993
BS 5760: Section 13.3: 1993 Reliability of systems, equipment and components: Guide to reliability test conditions for consumer equipment: Conditions providing a low degree of simulation for equipment for stationary use in partially weatherprotected locations	Reviewed in Section 5, Chapter 5 of this document.	Identical to IEC 605-3-3: 1993
BS 5760: Section 13.4: 1993 Reliability of systems, equipment and components: Guide to reliability test conditions for consumer equipment: Conditions providing a low degree of simulation for equipment for portable and non-stationary use	Reviewed in Section 5, Chapter 6 of this document.	Identical to IEC 605-3-4: 1993
BS 5760: Part 14: 1993 Reliability of systems, equipment and components: Guide to formal design review	Reviewed in Section 9, Chapter 3 of this document.	Identical to IEC 1160: 1992

TABLE 3-3: BSI STANDARDS CONTAINED IN BSI QMH PART 2: MAINTAINABILITY

Document Title	Description	Notes
BS 4778: Section 3.1: 1991 Quality Vocabulary: Availability, reliability and maintainability terms: Guide to concepts and related definitions	Reviewed in Section 2, Chapter 5 of this document.	
BS 4778: Section 3.2: 1991 Quality Vocabulary: Availability, reliability and maintainability terms: Glossary of international terms	Reviewed in Section 2, Chapter 1 of this document.	Identical to IEC 50-191: 1990
BS 6548: Part 1: 1984 Maintainability of equipment: Guide to specifying and contracting for maintainability	Reviewed in Section 6, Chapter 1 of this document.	Identical to IEC 706-1: 1982
BS 6548: Part 2: 1992 Maintainability of equipment: Guide to maintainability studies during the design phase	Reviewed in Section 6, Chapter 2 of this document.	Identical to IEC 706-2: 1992
BS 6548: Part 3: 1992 Maintainability of equipment: Guide to the maintainability, verification, and the collection, analysis and presentation of maintainability data	Reviewed in Section 6, Chapter 3 of this document.	Identical to IEC 706-3: 1987
BS 6548: Part 4: 1995 Maintainability of equipment: Guide to the planning of maintenance and maintenance support	Reviewed in Section 6, Chapter 4 of this document.	Identical to IEC 706-4: 1992
BS 6548: Part 5: 1995 Maintainability of equipment: Guide to diagnostic testing	Reviewed in Section 6, Chapter 5 of this document.	Identical to IEC 706-5: 1994
DD 198: 1991 Guide to assessment of reliability of systems containing software	Reviewed in Section 4, Chapter 12 of this document.	

CHAPTER 14: ARMP-2, EDITION NO. 2: GENERAL APPLICATION GUIDANCE ON THE USE OF ARMP-1*

*Equivalent to British Ministry of Defence (MOD) Defense Standard 00-40: Part 2: Reliability and Maintainability Part 2: General Applications Guidance on the Use of Part 1.

This document is dated October 1993, and contains 79 pages. Price: $28.50

14.1 Document Outline

Chapter 1 Introduction
- Para. 101 General
- Para. 102 Scope
- Para. 103 Applicability
- Para. 104 Terminology
- Para. 105 Related Documents

Chapter 2 General Requirements for R&M
- Para. 201 Introduction
- Para. 202 Quantitative R&M Requirements
- Para. 203 Maintenance Concept & Supportability
- Para. 204 R&M Programme
  - (a) Reliability Engineering
  - (b) Maintainability Engineering
  - (c) R&M Traceability
  - (d) R&M Documentation
- Para. 205 R&M Programme Management, Interfaces and Coordination

Chapter 3 R&M Tasks
- Para. 301 Introduction
- Para. 302 Integration of R&M In Design
- Para. 303 R&M Programme Plans
- Para. 304 Monitor and Control of Sub-Contractors and Suppliers
- Para. 305 Integration of Government Furnished Equipment (GFE)
- Para. 306 Design Reviews
- Para. 307 Analysis of the Operating and Environmental Conditions
  - (a) Duty Cycles
  - (b) Environmental Conditions
  - (c) Effects of Manufacturing, Testing, Storage, Shelf-Life, Packaging, Transportation, Handling and Maintenance
- Para. 308 Reliability Design Criteria
- Para. 309 Maintainability Design Criteria
- Para. 310 R&M Trade-off Studies
- Para. 311 Parts and Materials Reliability

Para. 312	R&M Modeling
Para. 313	R&M Allocations
Para. 314	R&M Predictions
Para. 315	R&M Failure Modes, Effects and Criticality Analyses (FMECA)
Para. 316	Fault Tree Analysis
Para. 317	Sneak Analysis
Para. 318	The Impact of Software on R&M
Para. 319	Human Impact on R&M
Para. 320	Derating
Para. 321	Critical Items
Para. 322	Life Limited Items
Para. 323	R&M and Integrated Logistic Support
Para. 324	Data Classification
Para. 325	Data Reporting Analysis and Corrective Action System (DRACAS)
Para. 326	Reliability Growth Test (RGT) Programme
Para. 327	R&M Qualification Test Programme
Para. 328	Environmental Stress Screening (ESS)
Para. 329	Production Reliability Acceptance Test (PRAT) Programme
Para. 330	In-service R&M

Annex I	- Contracting for R&M
Annex II A	- Reliability Tasks
Annex II B	- Maintainability Tasks
Annex II C	- Code Explanation

14.2 Document Abstract

This document provides application guidance for each of the statements and paragraphs of ARMP-1, NATO Requirements for Reliability and Maintainability. Information, rationale and tailoring guidance is included. In addition to the guidance information, this document is meant to provide commonality of interpretation of R&M tasking between contractor and purchaser.

14.3 Principal Features of the Document

Each paragraph of ARMP-1 is quoted verbatim in this document, followed by guidance information on the purpose of the task, considerations for both the purchaser and contractor, and in some cases, suggested items to be considered or provided as part of task performance. In all cases, the guidance stresses the need to consider each R&M

task against the cost, performance and timescale factors associated with the program. Other parts of the guidance provided stress coordination with other engineering support groups (i.e., logistics, safety, systems, quality assurance, etc.) to avoid duplication of effort and to be aware of information of value to R&M. The application of R&M within a concurrent engineering environment, rather than in isolation, is also suggested as the only way to guarantee an effective R&M program.

In the introductory section of this guide, wording is provided that stresses the use of motivation to achieve R&M by linking achievement to payment. In particular, the guide suggests this be accomplished by having specific R&M requirements form an essential element of the total compliance, having milestone payments linked to achievement, requiring R&M demonstrations, requiring in-Service support by the contractor for a fixed length of time, negotiating warranties, and providing R&M incentives.

14.4 Limitations/Tailoring Recommendations

The guidance provided within this document is limited to R&M tasking contained within ARMP-1. The information is an excellent source for any R&M practitioner or manager in how, when and where to use specific R&M tasks in supporting the achievement of high availability. Used in combination with ARMP-1 or any other R&M program management standard, this guidance document should prove to be very effective in efficient tailoring of R&M to most any program.

CHAPTER 15: NASA NHB 5300.9 - SAFETY, RELIABILITY, AND QUALITY ASSURANCE PROVISIONS FOR THE OFFICE OF AERONAUTICS, EXPLORATION AND TECHNOLOGY CENTERS

This document is dated July, 1991 and contains 43 pages. Price: $50.00

15.1 Outline of Document

Preface

Chapter 1: Introduction
- 100 Purpose
- 101 Authority
- 102 Applicability
- 103 Approach
- 104 Responsibilities
- 105 Relation to other contract and program requirements
- 106 SR&QA life cycle

Chapter 2: Project Risk Classification And Requirements Selection
- 200 General
- 201 Project risk classification
- 202 Project SR&QA task selection

Appendices

Appendix A: Safety Program Tasks/ Requirements
- A.1 System safety
- A.1.1 Safety requirements definition
- A.1.2 System safety program plan (SSPP)
- A.1.3 Safety design criteria
- A.1.4 System safety training
- A.1.5 Design review participation
- A.1.6 Supplier safety oversight
- A.1.7 Preliminary hazard analysis (PHA)
- A.1.8 Subsystem hazard analysis (SSHA)
- A.1.9 Fault tree analysis (FTA)
- A.1.10 System hazard analysis (SHA)
- A.1.11 Operating and support hazard analysis (O&SHA)
- A.1.12 Software hazard analysis
- A.1.13 Hazard reporting/ tracking/corrective action
- A.1.14 Hazardous materials control
- A.1.15 Test plan safety inputs
- A.1.16 Safety surveys
- A.1.17 Test data review
- A.1.18 Residual risk assessment report
- A.1.19 Safety Assessment Report (SAR)
- A.1.20 Acceptable risk recommendations
- A.1.21 Safety statement
- A.1.22 Operational readiness review/flight readiness review (ORR/FRR)
- A.1.23 Airworthiness panel reviews
- A.1.24 Pre-Operation/pre-flight briefing
- A.1.25 Human rating reviews
- A.2 Institutional safety and health
- A.2.1 Institutional safety and health program plan
- A.2.2 Applicable code requirements analysis
- A.2.3 Code compliance survey
- A.2.4 Facility design support
- A.2.5 Construction safety review
- A.2.6 Operational safety and health training
- A.2.7 Hazardous materials control

A.2.8 Fire hazard analysis
A.2.9 Hazardous operations procedure analysis
A.2.10 Protective equipment control
A.2.11 Industrial safety and health surveys
A.2.12 Public safety risk analysis
A.2.13 Environmental analysis

Appendix B: Reliability Program Tasks/Requirements

B.1 Reliability requirements definition
B.2 Reliability program plan
B.3 Reliability design criteria
B.4 Reliability training
B.5 Design review participation
B.6 Supplier reliability oversight
B.7 Failure modes, effects, and criticality analysis/single failure point analysis (FMECA/SFPA)
B.8 Reliability model/allocation
B.9 Reliability prediction
B.10 Problem reporting and corrective action (PRACA)
B.11 Parts and materials selection/application
B.12 Nonstandard Parts approval
B.13 Government/industry data exchange program (GIDEP)
B.14 Circuit stress/functional analysis
B.15 Thermal analysis
B.16 Environmental requirements analysis
B.17 Worst-case analysis
B.18 Sneak analysis
B.19 Test plan inputs
B.20 Reliability demonstrations
B.21 Test data review
B.22 Reliability assessment
B.23 Failure mode/single failure point retention rationale report
B.24 Maintainability design criteria
B.25 Maintenance concept development
B.26 Spares requirements analysis
B.27 Availability prediction
B.28 Maintenance task analysis
B.29 Test point design analysis
B.30 BIT/BITE analysis
B.31 Pre-op/Pre-flight test requirements

Appendix C: Quality Assurance Program Tasks/Requirements

C.1 Quality assurance requirements definition
C.2 Quality program plan
C.3 Quality assurance training
C.4 Quality assurance delegation
C.5 Design review participation
C.6 Configuration management (hardware and software)
C.7 Procurement source control
C.8 Government source inspection
C.9 Receiving inspection
C.10 Parts and materials screening/control
C.11 Fabrication operations control
C.12 Cleanliness control
C.13 Test specification preparation/review
C.14 Acceptance/qualification test participation
C.15 Software verification and validation participation
C.16 In-process inspection
C.17 Mandatory inspection points
C.18 Quality assurance surveys
C.19 Government property control
C.20 Nonconforming article control
C.21 Design deficiency reporting

15.2 Document Abstract

This guide book outlines the safety, reliability and quality assurance program requirements for flight and ground-based projects conducted at the following NASA research centers: Ames, Langley, and Lewis. The information contained within is applicable to all projects at these Centers, except for one covered by more stringent or restrictive requirements such as the Space Shuttle, Space Station, or unmanned spacecraft programs.

15.3 Principal Features of the Document

A majority of the guidance information provided resides in the Appendixes to the guide, as evidenced in the document outline section above. The first part of this guide presents the general requirements for safety, reliability (including maintainability) and quality assurance (SR&QA). The guidance provided in this part of the handbook requires that tailoring of the program SR&QA tasks be tailored according to the level of project risk. Project risk classifications, as well as organizational structure and program milestones, are well defined in this part of the handbook.

The information provided on risk defines four classes of risk, with Class 1 being the highest. Overall project risk is defined as a combination of risk factors for four categories within each class. These categories are human, financial, technical, and visibility. As guidance, qualitative meanings to high, medium, low and minimum risk are provided for each of the four categories. Further guidance is provided by example,

wherein 12 actual NASA projects are described (in Appendix D) and their risk ratings are shown in table format. These projects are further used as an example of which SR&QA tasking was performed, relative to the overall risk ratings for each.

The second part of the handbook is the Appendixes, where definitions and some guidance in provided for each of the SR&QA tasks defined. The guidance provided for the safety tasks is quite extensive and includes purpose of each task and examples of information to be provided. The reliability task guidance, which includes maintainability as well, is more general in nature, as other NASA handbooks provide more detailed guidance for these tasks (see description of NASA document NHB 5300.4(1A-1)). The same holds true for the guidance on quality tasking, wherein more detailed guidance in provided in other NASA and DoD documents.

15.4 Limitations/Tailoring Recommendations

There are no major limitations in using this document for other, non-NASA procurements. The information contained within is meant to be tailored based on overall project risk as defined in the handbook. Guidance is provided on defining risk, and examples are given for several existing NASA programs. Further guidance on tailoring is provided in that the SR&QA tasking for each of the NASA programs referred to is also provided. As always, engineering judgment must be used for such tailoring. The most effective tailoring will require use of additional NASA and other standards and handbooks referred to for each of the areas covered in this handbook (i.e., SR&QA).

SECTION 4
ANALYSIS TECHNIQUES

PREFACE

This section contains reviews of documents that can be used as handbooks or specification guides for specific R&M analysis techniques. For instance, if a failure modes and effects analysis (FMEA) is desired on any particular product development project, the FMEA could be in accordance with one of those documents on FMEAs reviewed within this chapter. These documents are also useful as reference documents in performing a particular analysis on a product, such as a Fault Tree Analysis (FTA) or development of a reliability block diagram (RBD).

US Military standards that fall under the category of analysis techniques, but have not been reviewed as part of this effort are listed below. The current status of these documents under DoD Acquisition Reform can be found in Section 11, Chapter 3.

- MIL-HDBK-217 Reliability Prediction of Electronic Equipment
- MIL-STD-756 Reliability Modeling and Prediction
- MIL-STD-1629 Procedures for Performing a Failure Mode Effects and Criticality Analysis
- MIL-STD-2165 Testability Program for Electronic Systems and Equipments

Chapter 1 IEC **300 - 3-1**
Dependability Management Part 3: Application Guide, Section 1: Analysis Techniques for Dependability: Guide on Methodology

Chapter 2 IEC **812**
Analysis Techniques for System Reliability - Procedure for Failure Mode and Effects Analysis (FMEA), First Edition, 1985

Chapter 3 IEC **863**
Presentation of Reliability, Maintainability and Availability Predictions, First Edition, 1986

Chapter 4 IEC **1025**
Fault Tree Analysis (FTA), First Edition, 1990

Chapter 5 IEC **1078**
Analysis Techniques for Dependability - Reliability Block Diagram Method, First Edition, 1993

Chapter 6 IEC **1165** - Application of Markov Techniques, First Edition, 1995

Chapter 7 SAE **AIR 4845**
The FMECA Process in the Concurrent Engineering (CE) Environment, June, 1993

Chapter 8 SAE **J 1739**
Surface Vehicle Recommended Practice: Potential Failure Mode and Effects Analysis in Design (Design FMEA) and Potential Failure Mode and Effects Analysis in Manufacturing and Assembly Processes (Process FMEA) Reference Manual, July 1994

Chapter 9 DSTAN **05-48**/Issue 1 The Reliability of a Series System

Chapter 10 BS **5760** Part 2 - Reliability of Systems, Equipment and Components: Part 2: Guide to Assessment of Reliability

Chapter 11 BS **5760** Part 5 Reliability of Systems, Equipment and Components: Part 5: Guide to Failure Modes, Effects and Criticality Analysis (FMEA and FMECA)

Chapter 12 (BSI) **DD198** - Assessment of Reliability of Systems Containing Software

CHAPTER 1: IEC 300 - 3-1 - DEPENDABILITY MANAGEMENT PART 3: APPLICATION GUIDE, SECTION 1: ANALYSIS TECHNIQUES FOR DEPENDABILITY: GUIDE ON METHODOLOGY

This document is dated 1991 and contains 39 pages. Price: $84.00

1.1 Outline of Document[*]

Foreword

Introduction

1. Scope

2. Normative references

3. Definitions

4. General

5. Basic approach to system dependability analysis
   - 5.1 General procedure
   - 5.2 Analysis of functional structure
   - 5.3 Deductive analysis
   - 5.4 Inductive analysis
   - 5.5 Maintenance and repair analysis and considerations

6. Characteristics of various dependability analysis methods
   - 6.1 Selecting an appropriate analysis method
   - 6.2 Short descriptions of analysis methods
   - 6.3 Explanations to Table 2
   - 6.4 Advantages and disadvantages of methods

ANNEX
   A Other references

1.2 Document Abstract

Dependability analysis techniques are used for the review and prediction of the reliability, availability, maintainability and safety measures of a system. Dependability analyses are conducted mainly during the concept and definition phase, the design and development phase, and the operation and maintenance phase at various system levels and degrees of detail in order to evaluate and determine the dependability measures of a system or installation. They are also used to compare the results of the analysis with specified requirements. This guide is an introduction to the available methodologies.

1.3 Principal Features of the Document

This standard gives a general overview of commonly used dependability analysis procedures. It describes the usual methodologies, the advantages and disadvantages, data input and other requirements for the various techniques. It is intended as an introduction to the available methodologies and provides the analyst with the necessary information in order to choose the analysis method most appropriate to the system.

A brief synopsis of the different types of analysis methods, when to use them and their relative advantages and disadvantages are highlighted. In addition, specific characteristics including the attributes of each analysis method, the number of components a given method can handle and the IEC document describing the analysis method are provided. Analysis methods described by the document include Failure Mode and Effects Analysis (FMEA), Failure Mode Effects and Criticality Analysis (FMECA), Fault Tree Analysis, Reliability Block Diagram, Markov Analysis, and Parts Count Reliability Prediction.

1.4 Limitations/Tailoring Recommendations

This is a very generic document applicable to almost any type of product and/or procurement methodology. No dependability analysis method is sufficiently comprehensive and flexible to deal with all the possible model complexities required to evaluate the features of practical systems (hardware and software, complex functional structures, various technologies, repairable and maintainable structures, etc.). It may be necessary to consider several analysis methods to ensure proper treatment of complex or multi-functional systems.

CHAPTER 2: IEC 812 - ANALYSIS TECHNIQUES FOR SYSTEM RELIABILITY - PROCEDURE FOR FAILURE MODE AND EFFECTS ANALYSIS (FMEA)

This document is dated 1985 and contains 41 pages. Price: $94.00 (82 CHF)

2.1 Outline of Document*

2.2 Document Abstract

This standard describes Failure Mode and Effects Analysis (FMEA) and Failure Mode, Effects and Criticality Analysis (FMECA), and provides guidance for their application. These reliability analysis methods are intended to identify failures which have significant consequences affecting system performance in the application considered. The general qualitative considerations for a FMEA also apply to FMECA, since one is an extension of the other.

2.3 Principal Features of the Document

This document provides a good overview of the FMEA process in that it defines background information necessary to perform an FMEA, or FMECA including concepts and definitions of the system functional structure. Information necessary to perform the FMEA is also provided, as well as a discussion of general terms and concepts relevant to the performance of an FMEA, such as failure modes, common-mode or common cause failures (CMF), human factors, software errors and criticality. The standard also does a good job outlining the various uses of an FMEA, as well as discussing its limitations. The described information is found in Sections 2 and 3 of the standard.

In addition to providing tutorial like information on the FMEA, the standard, in Section 4, outlines a general 11-step procedure for performing an FMEA, including steps for criticality analysis. The remainder of Section 4 provides a discussion of each of the steps outlined, including rationale. Also included are examples of general and specific failure modes and causes, and example FMEA and FMECA worksheets that can be used to document results.

2.4 Limitations/Tailoring Recommendations

This standard provides a general overview of FMEA and FMECA background information and an overview of a general procedure for performing the FMEA. It stresses the level at which the FMEA can be performed is not limited, and therefore the methods and procedures presented are applicable to all system levels and system development phases. The only real limitation is in the amount of data that is available to clearly define system functions, performance requirements, environments and failure modes. The standard does not provide any detailed examples, such as case studies of actual or hypothetical systems, and is therefore best used as a management tool or

introductory guide to novice reliability engineers. As a management tool, the document does provide sufficient detail as to what information is required, the uses of an FMEA or FMECA, and the other system functions that should be involved. It lacks primarily in providing detailed examples. For instance, while stating that links between the FMEA (FMECA) and other qualitative and quantitative analytical methods should be defined, prior to performing the FMEA, no specific examples are given.

Notice of Disclaimer: All material concerning this IEC document, except the document outline, was prepared by IIT Research Institute, operators of the RAC, under contract to the US Air Force Rome Laboratory. All such material is the sole responsibility of the IIT Research Institute.

CHAPTER 3: IEC 863 - PRESENTATION OF RELIABILITY, MAINTAINABILITY AND AVAILABILITY PREDICTIONS*

*Identical to BSI Document BS 5760: Part 12: 1993 - Reliability of Systems, Equipment and Components: Guide to Presentation of Reliability, Maintainability and Availability Predictions.

This document is dated 1986 and contains 24 pages. Price: $43.00 (45 CHF)

3.1 Outline of Document♦

Foreword

Preface

1. Scope

2. Object

3. Definition of terms

4. Contents of the presentation

5. Detail requirements of the presentation
   - 5.1 Summary
   - 5.2 Purpose of prediction
   - 5.3 Object of prediction
   - 5.4 Characteristics
   - 5.5 Requirements and conditions
   - 5.6 Analysis
   - 5.7 Models
   - 5.8 Data sources
   - 5.9 Calculation principles
   - 5.10 Prediction results

Appendix A: Prediction tasks

3.2 Document Abstract

This standard defines the items that should be considered for the presentation of information regarding predictions of quantitative characteristics of reliability, maintainability and availability of systems and equipment, including hardware, software and human elements.

3.3 Principal Features of the Document

This document provides a complete listing of all items to be considered in making a proper and full presentation of prediction information. This recommended way of presentation is intended to facilitate comparisons between projects or reports.

The purpose of a presentation of information on a prediction is to provide a reader with sufficient information to evaluate the prediction results and the principles and means by which these results were obtained.

3.4 Limitations/Tailoring Recommendations

A comprehensive list of information to be assembled in a reliability, maintainability or availability prediction report is presented. However, the information listed is in general terms. Some examples are given for each category of data, but they are general in nature. The document does state that depending on the prediction task, all information may not be applicable, yet little to no guidance on making such determinations is provided.

CHAPTER 4: IEC 1025 - FAULT TREE ANALYSIS (FTA)*

*Identical to BSI Document BS 5760: Part 7: 1991 - Reliability of Systems, Equipment and Components: Guide to Fault Tree Analysis.

This document is dated 1990 and contains 42 pages. Price: $98.00 (73 CHF)

4.1 Outline of Document*

4.2 Document Abstract

This standard describes fault tree analysis by defining a basic system structure and approach to fault tree construction. A step-by-step procedure is presented showing example fault tree figures and presenting specific analysis techniques including boolean reduction and methods of minimal cut sets.

4.3 Principal Features of the Document

This publication gives a general overview of fault tree analysis and provides guidance on its application by defining basic principles, providing steps necessary to perform an analysis, and by identifying appropriate assumptions, events and failure modes. Logical (qualitative) and numerical (quantitative) fault tree analysis methods are discussed. Though a specific report format documenting the results of a FTA is not presented, the basic items required by such a report are provided. Information is also provided on the basic fault tree symbols and identification rules.

4.4 Limitations/Tailoring Recommendations

While a good deal of information is provided on the objective of a fault tree analysis and the basic approaches to take in fault tree development, it lacks somewhat on providing examples that would help facilitate learning. The symbols used are also not those most commonly used in the US. Rather than using logic gate symbols (i.e., AND gate, OR gate, EXCLUSIVE OR gate), boxes with descriptive information are used in all examples. An appendix is provided, however, with both sets of symbols. This publication is applicable to any type of system and during any system life cycle phase.

CHAPTER 5: IEC 1078 - ANALYSIS TECHNIQUES FOR DEPENDABILITY - RELIABILITY BLOCK DIAGRAM METHOD*

*Identical to BSI Document BS 5760: Part 9: 1992 - Reliability of Systems, Equipments and Components: Guide to the Block Diagram Technique.

This document is dated 1993 and contains 57 pages. Price: $88.00 (94 CHF)

5.1 Outline of Document•

Foreword

Introduction

1. Scope
2. Normative references
3. Definitions
4. Symbols
5. Applicability
6. System fault definitions and reliability requirements
   - 6.1 General considerations
   - 6.2 Detailed considerations
7. Elementary Models
   - 7.1 Developing the model
   - 7.2 Evaluating the model
8. More complex models
   - 8.1 General procedures
   - 8.2 Models with common blocks
   - 8.3 *m* out of *n* models (non-identical items)
9. Extension of reliability block diagram methods to availability calculations
   - 9.1 Introduction
   - 9.2 Assumptions
   - 9.3 Examples
   - 9.4 Conclusions and general remarks

ANNEXES
- A Symbols and abbreviations
- B Summary of formulae

5.2 Document Abstract

Different analytical methods of dependability analysis are available, of which the Reliability Block Diagram (RBD) is one. A RBD is a pictorial representation of a system's reliability performance. It shows the logical connection of (functioning) components needed for system success. This standard provides modelling techniques to be used in the construction of a RBD.

5.3 Principal Features of the Document

This standard describes procedures for modelling the dependability of a system and for using the model to calculate reliability and availability measures. Prerequisites to constructing system reliability models, the steps required to develop a system RBD and elementary and complex methods to model system redundancy are provided.

5.4 Limitations/Tailoring Recommendations

The modelling techniques described are intended to be applied primarily to systems without repair and where the order in which failures occur does not matter. For systems where the order of failures must be taken into account or where repairs are to be carried out, other modelling techniques, such as Markov analysis, are more suitable. At any instant in time, an item is considered to be in only one of two possible states: operational or faulty.

CHAPTER 6: IEC 1165 - APPLICATION OF MARKOV TECHNIQUES

This document is dated January, 1995 and contains 23 pages. Price: $95.00

6.1 Outline of Document*

Foreword

Introduction

1. Scope
2. Normative references
3. Definitions
4. Symbols
   - 4.1 State-transition diagram
   - 4.2 Dependability measures
   - 4.3 Example
5. General
6. Assumptions
7. Development of Markov diagrams
   - 7.1 Precautions
   - 7.2 Rules
   - 7.3 Examples
8. Evaluation of state-transition diagrams
   - 8.1 General
   - 8.2 Evaluation of reliability
   - 8.3 Evaluation of availability and maintainability
9. Simplifications and approximations
10. Collapsed state-transition diagram
11. Reliability and availability expressions for system configurations
12. Presentation of results

Annexes
- A Example: Numerical evaluation of some dependability measures of a two-unit active redundant system
- B Tables of reliability and availability expressions for basic configurations
- C Bibliography

6.2 Document Abstract

This standard provides guidance on the application of Markov techniques to dependability analysis. Several distinct analytical methods of dependability analysis are available, of which Markov analysis is one method. IEC 300-3-1 gives an overview of available methods and their general characteristics. The relative merits of various methods and their individual or combined applicability in evaluating the dependability of a given system or component, should be examined by the analyst prior to deciding on the use of Markov analysis.

6.3 Principal Features of the Document

The document provides guidance on the application of Markov techniques to dependability analysis. A Markov analysis makes use of a state-transition diagram which is a pictorial representation of the dependability performance of a system. It models the dependability aspects of the system's behavior with time. The analysis is especially suited to the dependability assessment of systems with redundancy, or to systems where system failure depends on sequential events, or to systems for which the maintenance strategies are complex, for example priority restoration, queuing problems, and resource restrictions.

The standard defines the symbols and abbreviations typically used in a Markov Analysis, the development and evaluation of state-transition diagrams and approximations which can be incorporated. In addition, elements which should be included in a report documenting the analysis results are provided. The document stresses that the analyst must ensure that the model created adequately reflects the operation of the real system with respect to maintenance strategies and policies. A critical task in Markov analysis is the proper design of the state-transition diagram. Subclause 7.2 gives some recommended rules. These rules must be established before the analysis is undertaken. This should provide for the proper identification of the individual states, enabling clear graphical models to be constructed.

6.4 Limitations/Tailoring Recommendations

The methods cited in the document are limited to the assumption of constant failure and repair rates for the elements within the system to be analyzed. The main body of the document outlines general methods and guidelines for modelling, while Appendix A provides limited examples of the mathematics involved in using the

models to determine dependability metrics. The document is not detailed enough to assist in the development and analysis of complicated models. For these situations, computer programs are typically employed.

CHAPTER 7: SAE AIR 4845 - THE FMECA PROCESS IN THE CONCURRENT ENGINEERING (CE) ENVIRONMENT

This document is dated June 18, 1993 and contains 52 pages. Price: $50.00

7.1 Outline of Document

Foreword

1. Scope

2. References

3. Technical Requirements
   - 3.1 FMECA Overview
   - 3.2 The Current FMECA Process
     - 3.2.1 FMECA Needs
     - 3.2.2 FMECA Requirements
     - 3.2.3 FMECA in the Current Design Process
     - 3.2.4 Initiating the FMECA
     - 3.2.5 FMECA Control/FMECA Control to a Hardware Configuration
     - 3.2.6 Generation of the FMECA Report
     - 3.2.7 Current Difficulties (With Generating FMECAs)
   - 3.3 FMECA in the Concurrent Engineering Environment
     - 3.3.1 The Role of the FMECA in the CE Environment
     - 3.3.3 Timing
     - 3.3.4 Users of the FMECA in a CE Environment
     - 3.3.5 Benefits of FMECA in the CE Environment
   - 3.4 Automation of FMECA Within CE
     - 3.4.1 Information Gathering
     - 3.4.2 Analyses
     - 3.4.3 Report Generation
     - 3.4.4 Today's Capabilities
     - 3.4.5 Needed Automation Capabilities
     - 3.4.6 Technology Needs (to Automate FMECA)
   - 3.5 Priority for FMECA Automation

4. Summary And Recommendations

Appendix A Examples Of Different Types of FMECA

7.2 Document Abstract

This document is neither a standard nor a specification, but a report on the Failure Mode, Effects and Criticality Analysis (FMECA) process as it exists today, and

recommendations for how it could exist within a concurrent engineering (CE) environment. The report provides an excellent overview of the FMECA process, when it should be done and by whom, and what functions benefit and interface directly with the process.

7.3 Principal Features of the Document

This document provides examples on the different types of FMECAs. An example using an actual system is included. Having defined the baseline of today, the report then explores how FMECAs could benefit from automation and the tools that are available and are being developed for the CE environment. This includes use of simulation tools and techniques as well as applying Artificial Intelligent (AI) techniques. More specifically, the report defines the CE environment, and then proceeds to explore the following areas that could be automated as part of the FMECA process: Information gathering/sharing, analyses (via simulation, e.g.), and report generation. Finally, the means available for providing the needed information in each of these areas is outlined and discussed.

7.4 Limitations/Tailoring Recommendations

The report is an excellent reference for managers or novice reliability engineers that need an overview of the FMECA process and how it can be used for design analysis and improvement. It is not recommended as a standard, specification or requirement document by the SAE, but rather as an informational report on the FMECA process, FMECA automation, and FMECA benefits today and in the future.

CHAPTER 8: SAE J1739 - SURFACE VEHICLE RECOMMENDED PRACTICE: POTENTIAL FAILURE MODE AND EFFECTS ANALYSIS IN DESIGN (DESIGN FMEA) AND POTENTIAL FAILURE MODE AND EFFECTS ANALYSIS IN MANUFACTURING AND ASSEMBLY PROCESSES (PROCESS FMEA) REFERENCE MANUAL

This document is dated July 1994 and contains 42 pages. Price: $45.00

8.1 Outline of Document

1. General Information
   - 1.1 Overview
   - 1.2 History
   - 1.3 Manual Format
   - 1.4 FMEA implementation

2. References

3. Potential failure mode and effects analysis in design
   - 3.1 Introduction
   - 3.2 Development of a design FMEA

4. Potential failure mode and effects analysis in manufacturing and assembly processes
   - 4.1 Introduction
   - 4.2 Development of a process FMEA

Appendix A Design FMEA block diagram example
Appendix B Design FMEA example
Appendix C Process FMEA flow chart/risk assessment examples
Appendix D Process FMEA example
Appendix E Glossary
Appendix F Standard form for design FMEA
Appendix G Standard form for process FMEA

8.2 Document Abstract

This document was jointly developed by Chrysler, Ford, and General Motors under the sponsorship of the United States Council for Automotive Research. It introduces the topic of potential Failure Mode and Effects Analysis (FMEA). General guidance is provided on two types of potential FMEA, Design and Process. A **Design** potential FMEA is an analytical technique utilized primarily by a Design Responsible Engineer/Team as a means to assure that, to the extent possible, potential failure modes and their associated cause/mechanisms have been considered and addressed. End items, along with every related system, subassembly and component, should be evaluated. A **Process** potential FMEA is an analytical technique also utilized in the same way as the Design potential FMEA but for a specific process, such as manufacturing, rather than the design itself. The Process FMEA assumes the design will function as intended.

8.3 Principal Features of the Document

This document is a stand-alone reference manual on two specific FMEA processes, called potential design FMEA and potential process FMEA. Developed by personnel from Chrysler, Ford and General Motors, this document combines what is considered traditional failure mode and effects analysis, with criticality assessment and a corrective action and follow-up process. Unique to this document is the inclusion of the Process FMEA, which focuses on manufacturing processes and analyzing failures that can occur and lead to problems with the end product. Emphasis is put on controlling the quality of the process, and not on improving the means of detecting problems. The format of the manual is to present an example FMEA worksheet, and explain the purpose of each of the columns. In addition to identifying failure modes and their effects, failure causes and mechanisms are also identified, along with the severity of the failure, the relative likelihood of failure cause/mechanism occurrence, and the relative likelihood of detecting the failure cause or failure mode using defined techniques. Guidance by way of example ratings tables are provided for each of the severity, occurrence and detection rankings. Unique to the FMEA technique presented is a process that calls for defined actions to be taken to either change the design or improve the process to eliminate the failure cause/mechanism, or if this is not possible, to implement procedures to better detect the problem. Further, a closed loop system is imbedded within the process in the form of a follow-up procedure to verify the effectiveness of changes/detection procedures.

8.4 Limitations/Tailoring Recommendations

Although the manual implies this to be an automotive document, the procedures described are applicable to any system and manufacturing process. Therefore, no major limitations exist in using this manual as the basis for FMEAs. This document is a manual, and therefore tailoring requirements are not applicable. However, the Process FMEA procedure includes as a first step the definition of all process steps considered, and identification of the relative risk each step has to system quality and performance. High risk steps then become candidates for the FMEA, and not the entire process. An example of this is provided in the document, and as such, this step in the process FMEA becomes a built in tailoring guide.

CHAPTER 9: DSTAN 05-48/ISSUE 1 THE RELIABILITY OF A SERIES SYSTEM

This document is dated 20 March, 1978 and contains 40 pages. Price: $45.00

9.1 Document Outline*

Preface

1 Scope
2 Definitions
3 Outline of the Method For Equal Sub-system Sample Sizes
4 Procedure For Determination of Lower Single Sided 95% Confidence Limit When the Sub-system Sample sizes Are Equal
5 Extension of Method to Sub-system Sample Sizes Which Are Unequal
6 Examples of the Method
7 Determination of Q (N, C) For N Outside Table A of DEF STAN 05-49

Table A Critical Values of n
Table B Formulae for Calculation of Limit

Annex A A Fortran IV Subroutine for Computing Q, the Lower single sided 95% confidence Limit for the Binomial Distribution

9.2 Document Abstract

This Defense Standard provides two specific methods for calculating the lower 95% confidence limit on system reliability given defect data taken from samples of the system's sub-systems. The methods are for series systems only, made up of two or more subsystems. One method is applicable to equal sample sizes for each subsystem, while the other method is for unequal sample sizes.

9.3 Principal Features of the Document

Detailed formulas and procedures are provided that will allow the calculation of a lower 95% confidence limit on reliability for a series system, using sub-system level data. Two different methods are presented. The first method is well described and depends on the application of one of four formulas. Instructions, both in narrative and flow chart format are provided to determine which formula to use. Several examples are presented to aid the user. The first method assumes equal sample sizes are drawn for each subsystem. This method requires knowing the total number of sub-systems, the sub-system sample size, the total number of observed sub-system failures, and the

test result signature. The test result signature is the total number of non-zero failures comprising 4 subsystems, where an equal number of each sub-system is tested, with the following results: r1=0, r2=2, r3=1, r4=2 (where r# is the number of failures for subsystem #). The test signature for this example would be 2 2 1. The first method is based on the binomial distribution and uses tables provided in DSTAN 05-49.

The second method is also well described and is based on the Poisson distribution. It is applicable to situations where the sub-system sample sizes are not equal. This method also calculates the lower 95% confidence limit on system reliability. As for the first method, explanations and examples are provided to aid in the use and application of the methods presented. This method could be used for equal sub-system sample size, however, it is not as accurate for this situation as the first method described above.

9.4 Limitations/Tailoring Recommendations

The methods provided are limited to series systems only. The methods also assume that any interconnection between subsystems are 100% reliable, and are therefore not considered. While the methods may be mathematically sound, the formulas depend on having a sufficient number of samples being tested for each subsystem. While this may be possible for a fielded system that has multiple copies available, the likelihood of having, say, 40 samples of each subsystem to test during development is remote. Therefore, at best, these methods may best be applied to tracking the reliability of fielded systems.

CHAPTER 10: BS 5760 PART 2 - RELIABILITY OF SYSTEMS, EQUIPMENTS AND COMPONENTS: PART 2. GUIDE TO THE ASSESSMENT OF RELIABILITY

This document is dated October 1994 and contains 104 pages. Price: $214.00

10.1 Outline of Document

Committees Responsible
Foreword
Introduction
Section 1. General
- 1.1 Scope
- 1.2 References
- 1.3 Definitions
- 1.4 Symbols

Section 2. Purposes and Problems
- 2.1 Purposes
- 2.2 Costs versus benefits
- 2.3 Using and presenting the results
- 2.4 Basic concepts
- 2.5 Assessment problems
- 2.6 Failure classification
- 2.7 Accuracy of assessment and prediction

Section 3 Assessment Throughout the Product Life Cycle
- 3.1 General
- 3.2 Definition phase
- 3.3 Design and development phase
- 3.4 Production phase
- 3.5 Installation and commissioning
- 3.6 Function and maintenance

Section 4. Fundamentals of Reliability Assessment
- 4.1 General
- 4.2 Function
- 4.3 Conditions of use
- 4.4 Time interval
- 4.5 Probability
- 4.6 Reliability and safety
- 4.7 Principles of reliability modelling
- 4.8 Redundancy
- 4.9 Computer tools for reliability assessment

Section 5. Assessment Techniques
- 5.1 Outlines of techniques
- 5.2 Assumptions

Section 6. Reliability Block Diagram (RBD) Technique
- 6.1 Application
- 6.2 Benefits
- 6.3 Limitations

10.2 Document Abstract

British Standard 5760 is designed as a series of documents to provide a standardized systematic approach ensuring that all communications concerning reliability programs are consistent and unambiguous. This document, Part Two of BS 5760, provides a basis for the preparation of a reliability program. It can be used in preparing documents concerned with the specification of reliability or with the reporting of reliability data or tests. Its specific focus is guidance for the practitioner on the assessment of the reliability of systems. The document includes a review of the range of techniques available for performing reliability assessments. The applicability of each technique, depending on the nature of the product and its state of development and use, is also described.

10.3 Principal Features of the Document

This document explains the purpose and problems of assessing reliability. A fairly thorough compilation of available assessment techniques is reviewed and the principal advantages and limitations of each technique is outlined. In addition to the more common assessment methods, sections are also included on the assessment of software reliability, human reliability and one-shot devices. The standard further addresses the extension of these techniques to the assessment of availability and to the assessment of reliability of services as well. The use of a variety of statistical distributions to analyze reliability data is described in a series of annexes.

10.4 Limitations/Tailoring Recommendations

This standard is designed as a guidance document, therefore tailoring is not applicable. The guidance in the document is applicable to two general types of products. They are: a) specialized products designed for a single or small number of specialized users, and b) products for which a wide potential market is perceived. In both cases the guidance given in this standard will be applicable, but the balance of the complementary involvement of user and supplier will need to be adjusted according to the circumstances particular to that program.

CHAPTER 11: BS 5760 PART 5 - RELIABILITY OF SYSTEMS, EQUIPMENT AND COMPONENTS: PART 5. GUIDE TO FAILURE MODES, EFFECTS AND CRITICALITY ANALYSIS (FMEA AND FMECA)

This document is dated December 1991 and contains 44 pages. Price: $143.00

11.1 Outline of Document

Committees Responsible
Foreword
- 0 Introduction

Section 1. General
- 1.1 Scope
- 1.2 Definitions

Section 2. Failure Modes and Effects Analysis
- 2.1 Introduction
- 2.2 Procedure
- 2.3 Application
- 2.4 Supplementary information

Section 3. Criticality Analysis
- 3.1 Introduction
- 3.2 Procedure
- 3.3 Supplementary information

Appendices
- A Summary of procedure for FMEA and FMECA
- B Examples of analyses
- B.1 Ranked contribution approach to criticality analysis
- B.2 FMECA Example 1. Fire protection system of an electric locomotive
- B.3 FMECA Example 2. Sub-system of a motor-generator set
- B.4 Example of a process FMEA
- C Bibliography

11.2 Document Abstract

British Standard 5760 is designed as a series of documents to provide a standardized systematic approach ensuring that all communications concerning reliability programs are consistent and unambiguous. This document, Part Five of BS 5760 describes failure mode and effects analysis (FMEA) and failure modes, effects and criticality analysis. The standard is based upon IEC 812 "Analysis Techniques for System Reliability - Procedure for Failure Mode and Effects Analysis (FMEA)" (see Chapter 2 of this section for a detailed description of IEC 812) and gives guidance as to how FMEA and FMECA may be applied to achieve various objectives connected with the development of reliable designs.

11.3 Principal Features of the Document

The standard describes the procedural steps necessary to perform an analysis, identifies appropriate terms, assumptions, failure modes and criticality measures, determines basic principles, provides examples of the necessary worksheets, and provides recommendations for applications of FMEA and FMECA.

Criticality is a combination of the severity of an effect and the probability or expected frequency of occurrence. When associated with a failure mode the criticality of the effect is spoken of as the criticality of the failure mode. It is frequently desirable to quantify criticality as an aid to decision making on the corrective actions needed and their priorities.

The general qualitative considerations presented for FMEA also apply to FMECA. However, FMEA can be performed on its own, whereas criticality analysis has to be carried out in conjunction with an FMEA. FMECA also differs from FMEA in that the former is quantitative. For these reasons the two methods are dealt with separately in this standard.

11.4 Limitations/Tailoring Recommendations

This standard is applicable to all systems at all levels. The standard does state, however, that FMEAs are most applicable to lower equipment levels involving a number of items and function complexity. The standard also cautions against indiscriminate specification of an FMEA and notes the laborious nature of an FMEA when applied to complex systems that have multiple functions across several sets of components.

CHAPTER 12: (BSI) DD 198 - ASSESSMENT OF RELIABILITY OF SYSTEMS CONTAINING SOFTWARE

This document is not to be regarded as an approved British Standard. Rather it is issued as a "Draft for Development" (DD) and is of a provisional nature. Certain requirements contained therein may need modification in the light of practical experience in its use.

The document is dated July 1991 and contains 84 pages. Price: $200.00

12.1 Outline of Document

12.2 Document Abstract

This draft for development document (DD) explores some of the techniques that are available for assessing the non-physical reliability of systems containing software. It gives guidance on the assessment of reliability of systems containing software in which failures are due to errors caused by unknown factors in the logic embodied during the definition, design and development phases of the system. The purpose, in its present form, is to provide feedback on the effectiveness of the methodologies enumerated herein in assessing software reliability.

12.3 Principal Features of the Document

This standard provides information and guidance on the procedures and models available to determine and control the reliability and quality of software. A great deal of emphasis is put on defining and baselining the software development process being used, and methods of data collection and data analysis. Several data collection forms are provided and explained for the following categories of data: incident report, fault

report, change report, software part report, process definition report, software use log (calendar time), software use log (usage time). The software part report has sections that are similar to a hardware failure mode, effects and criticality analysis wherein the consequences of various categories of failures are recorded.

The above mentioned forms and processes provide an outline for any organization that needs to develop processes and procedures for software reliability data collection and assessment. In addition to data collection, the standard also presents the different methods of data analysis techniques in general, and software data analysis and modelling techniques specifically. Over 30 different models and techniques are either mentioned or reviewed. References to all models or analysis techniques mentioned are provided in Appendix A to the standard.

As a draft for development, or trial use standard, the information provided should be useful as both background information for those not familiar with software reliability as well as a guidance document for software reliability practitioners who want to develop a structured approach to software reliability analysis and control.

12.4 Limitations/Tailoring Recommendations

This document is not an approved standard, it is a draft for development document and therefore must be treated as such. However, there is no reason why it could not be used as a guide for any organization. Statements are provided up-front in the document concerning the fact that the effectiveness or usefulness of any of the software analysis and modelling techniques presented have not been determined. Therefore, all information presented must be viewed with this in mind. While there is no guidance provided concerning tailoring of the information provided, this draft guide could be used as a reference source, as a minimum.

SECTION 5
TESTING

PREFACE

A test can be defined as a critical trial or examination. In the R, M & A disciplines, tests are designed to examine the R, M & A characteristics of a product design to determine, for example, whether that design meets specified parameters such as mean time between failure (MTBF) or mean time to repair (MTTR). Such tests have historically been known as demonstration tests. Other kinds of tests, such as a reliability growth test, are designed to improve the product by uncovering design or manufacturing flaws, analyze and define the root causes and to develop and implement corrective actions.

US R&M military documents historically associated with test and used for guidance or requirements development and verification are listed below. The current status of these documents under DoD Acquisition Reform can be found in Section 11, Chapter 4. The documents reviewed within this section concern themselves exclusively with reliability testing, and include test analysis, test development, and test planning based on noted statistical procedures and processes. In some cases, terms such as compliance testing rather than demonstration testing are used. Test standards for maintainability are reviewed in Section 6, Maintainability.

- MIL-STD-781 Reliability Testing for Engineering Development, Qualification and Production
- MIL-STD-810 Environmental Test Methods and Engineering Guidelines
- MIL-STD-1635 Reliability Growth Tests
- MIL-STD-2068 Reliability Development Tests
- MIL-STD-2074 Failure Classification for Reliability Testing
- MIL-STD-2164 Environmental Stress Screening Process for Electronic Equipment

Chapter 1 IEC **605 - 1**
Equipment Reliability Testing - Part 1: General Requirements
First Edition; 1978 and Amendment 1, 1982

Chapter 2 IEC **605 - 2**
Equipment Reliability Testing - Part 2: Design of Test Cycles First Edition, 1994

Chapter 3 IEC **605 - 3-1**
Equipment Reliability Testing - Part 3: Preferred Test Conditions Indoor Portable Equipment - Low Degree of Simulation First Edition, 1986

Chapter 4 IEC **605 - 3-2**
Equipment Reliability Testing - Part 3: Preferred Test Conditions Equipment for Stationary Use in Weatherprotected Locations - High Degree of Simulation, First Edition, 1986

Chapter 5 IEC **605 - 3-3**
Equipment Reliability Testing - Part 3: Preferred Test Conditions Section 3: Test Cycle 3: Equipment for Stationary Use in Partially Weatherprotected Locations - Low Degree of Simulation, First Edition, 1992

Chapter 6 IEC **605 - 3-4**
Equipment Reliability Testing - Part 3: Preferred Test Conditions Section 4: Test Cycle 4: Equipment for Portable and Non-Stationary Use - Low Degree of Simulation, First Edition, 1992

Chapter 7 IEC **605 - 4**
Equipment Reliability Testing - Part 4: Procedures for Determining Point Estimates and Confidence Limits for Equipment Reliability Determination Tests, First Edition; 1986 and Amendment 1, 1989

Chapter 8 IEC **605 - 6**
Equipment Reliability Testing - Part 6: Tests for the Validity of a Constant Failure Rate Assumption, First Edition; 1986 and Amendment 1, 1989

Chapter 9 IEC **605 - 7**
Equipment Reliability Testing - Part 7: Compliance Test Plans for Failure Rate and Mean Time Between Failures Assuming Constant Failure Rate Clause 6 - Procedures for Design and Application of Time Terminated Test Plans, First Edition; 1978 and Amendment 1, 1990

Chapter 10 IEC **1070**
Compliance Test Procedures for Steady-State Availability, First Edition, 1991

Chapter 11 IEC **1123**
Reliability Testing Compliance Test Plans for Success Ratio, First Edition, 1991

Chapter 12 IES - Environmental Stress Screening Guidelines for Assemblies, March 1990

Chapter 13 IEC **1163 -1** - Reliability Stress Screening - Part 1: Repairable Items Manufactured In Lots, First Edition, 1995

Chapter 14 IEC **1164**
Reliability Growth - Statistical Test and Estimation Methods, First Edition, 1995

Chapter 15 DSTAN **00-43** (Part 1)/Issue 1 Reliability and Maintainability Assurance Activity Part 1: In-Service Reliability Demonstration

CHAPTER 1: IEC 605 - 1 - EQUIPMENT RELIABILITY TESTING - PART 1: GENERAL REQUIREMENTS*

*Identical to BSI Document BS 5760: Section 10.1: 1993 - Reliability of Systems, Equipment and Components: Guide to Reliability Testing: General Requirements

The original document is dated 1978 and contains 59 pages.
Price: Original; $108.00 (94 CHF)
Amendment No. 1 is dated December 1982 and contains 7 pages.
Price: Amendment; $24.00 (25 CHF)

1.1 Outline of Document♦

1. Introduction
2. Object of this standard
3. Applicability of the methods given
4. Definitions and related documents
5. Principles of reliability compliance testing
6. Principles of reliability determination testing
7. Test item sampling and statistical test plans
8. Test conditions
9. Test item performance and test observations
10. General test procedure
11. Field testing considerations
12. Test reports
13. Summary

1.2 Document Abstract

This standard is one element in a group of standards which provide information on the general requirements and procedures to be followed when specifying reliability compliance or determination testing. The concepts of compliance and determination are defined in this standard as: **Reliability compliance test -** an experiment used to show whether or not the value of a reliability characteristic of an item meets its stated reliability requirements, and **Reliability determination test -** an experiment used to determine the value of a reliability characteristic of an item.

1.3 Principal Features of the Document

The standard provides an excellent outline of the kinds of information that must be defined and asked for when specifying reliability compliance testing. In particular, the standard covers methods and principles of reliability compliance testing, test item sampling and statistical test plans, test conditions, test item performance, and test observations, relevant test time, field test considerations and test reports.

All methods described are applicable to electric, electromechanical, mechanical, pneumatic and hydraulic systems, and when reliability is expressed in terms of failure rate, mean time between failures, mean time to first failure, or success ratio. Procedures, methods and information to specify as part of an overall reliability compliance test program are also outlined.

Under test item sampling, the standard provides background and guidance information on how to choose a test plan, types of distributions and assumptions regarding failure distributions prior to testing, and on sequential test plans and time/failure terminated test plans and their advantages and disadvantages. Additional details and guidance are provided on how and when to monitor test results, failure classification, defining accept/reject criteria, conducting field reliability tests and finally, test reporting.

1.4 Limitations/Tailoring Recommendations

The principles set forth in this standard are applicable to all types of equipment. The standard is designed to be tailored depending on the type of reliability testing needed (i.e., compliance or determination), or the particular program phase to be addressed. Individual paragraphs can also be used for specifying reliability data collection and analysis activities, beyond the context of compliance or determination testing.

CHAPTER 2: IEC 605 - 2 - EQUIPMENT RELIABILITY TESTING - PART 2: DESIGN OF TEST CYCLES*

*Identical to BSI Document BS 5760: Section 10.2: 1993 - Reliability of Systems, Equipment and Components: Guide to Reliability Testing: Design of Test Cycles.

This document is dated 1994 and contains 61 pages. Price: $108.00

2.1 Outline of Document•

Foreword

Introduction

1. Scope
2. Normative references
3. Definitions
4. Relations between test conditions and conditions of use
5. Description of the conditions of use
   - 5.1 Operating conditions
   - 5.2 Environmental conditions
   - 5.3 Interrelationship between operating and environmental parameters
6. Procedure for the design of test cycles
7. Summary of documentation of a reliability test cycle

Annex A - Worked example

2.2 Document Abstract

This document provides a general procedure for the design of test cycles, where no applicable preferred test cycles can be found in IEC 605-3, "Equipment Reliability Testing - Part 3: Preferred Test Conditions." It applies to the design and operating and environmental test cycles referred to in the detailed reliability test specification.

It is to be used in conjunction with IEC-605-1, *Equipment reliability testing. Part 1: General requirements* and other documents in this series. Tests which include cycles designed according to this standard are not intended to replace ordinary tests such as qualification tests, functional tests and environmental tests.

2.3 Principal Features of the Document

Guidance is given on the definition of both environmental and operating parameters, including severities that can be used in the design of the test cycle. General information is provided in describing relations between test conditions and actual use conditions. Background on use conditions, to be defined, is also provided in terms of operation, environment (climatic, mechanical and other parameters) and the interrelationship between them.

The most principle feature is an outlined seven step procedure for defining a test cycle. Step 1 covers division of the equipment life into distinct phases where the test cycle duration would be proportionate to the overall life cycle phase. Step 2 deals with identifying relevant operating and environmental parameters and their interrelationships. Step 3 is an evaluation of parameter severities (both operational and environmental). Step 4 is an evaluation of any relevant combinations of parameters, including ones dependent on another (such as operation depends on power) and ones that are mutually exclusive. Step 5 sums all phases (times, severities, etc.) into a quantitative table to be used as input in defining the test cycle. Step 6 is a critical review of all information for relevancy or difficulty in recreating parameters and their severities in a test. Finally, Step 7 describes the detailed designing of the test cycle using information gathered in previous steps.

General guidance is provided for each step, including example tables documenting phases, parameters, interrelationships and severities, where applicable. An example is provided in the annex for a sample system.

2.4 Limitations/Tailoring Recommendations

The step-by-step procedure described in this document is intended for any specific equipment to be tested, when it is considered necessary to simulate closely the real conditions of use of the equipment. It applies fully to laboratory testing, but may also be applied to field testing, in so far as conditions can be controlled, with respect to operating conditions only (including load, supply, etc.).

Pre-exposure tests may in some cases be necessary before commencing the test cycles designed by methods of this standard. The basis of the decision as to whether to include pre-exposure tests is outside the scope of the standard.

CHAPTER 3: IEC 605 - 3-1 - EQUIPMENT RELIABILITY TESTING - PART 3: PREFERRED TEST CONDITIONS INDOOR PORTABLE EQUIPMENT - LOW DEGREE OF SIMULATION*

*Identical to BSI Document BS 5760: Sections 13.1: 1993 - Reliability of Systems, Equipment and Components: Guide to Reliability Test Conditions for Common Equipment: Conditions Providing a Low Degree of Simulation for Indoor Portable Equipment.

This document is dated 1986 and contains 22 pages. Price: $39.00

3.1 Outline of Document•

Foreword

Preface

1. Scope
2. Introduction
3. Applicability
   - 3.1 Type of equipment
   - 3.2 Operating conditions
   - 3.3 Environmental conditions
   - 3.4 Degree of simulation
   - 3.5 Examples
4. Basic assumptions underlying the severities
   - 4.1 Operating conditions
   - 4.2 Climatic conditions
   - 4.3 Mechanical conditions
   - 4.4 Other conditions
5. Pre-exposure tests
6. Description of the test cycle
   - 6.1 Relevant period of equipment life covered by the test cycle
   - 6.2 Operating conditions
   - 6.3 Climatic conditions
   - 6.4 Mechanical stress
   - 6.5 Permissible modifications
7. Relevant test time

3.2 Document Abstract

This document provides preferred test conditions for indoor portable equipment operating in a stationary position. It is to be used in conjunction with IEC-605-1, *Equipment reliability testing. Part 1: General requirements* and other documents in this series. It contains preferred test conditions as referred to in sub-clause 8.4 of IEC 605-1. Whenever possible, test cycles should be chosen from among those given in this or other sections of IEC 605-3. For applications not covered by IEC 605 Part 3, appropriate test cycles should be designed using IEC 605-2, "Equipment Reliability Testing - Part 2: Design of Test Cycles."

3.3 Principal Features of the Document

This document provides preferred test conditions for indoor portable equipment operating in a stationary position. It is to be used in conjunction with IEC-605-1. Test cycles which have a low degree of simulation can be developed using this standard. Test cycles are sequences of different operating and environmental test conditions which are based upon actual conditions of use, as defined, for example, by the relevant product specification. The equipment undergoing reliability testing is normally subjected to repeated test cycles. The number of cycles will depend on the accumulated relevant test time, as required by the selected compliance test plan of IEC 605-7, "Equipment Reliability Testing - Part 7: Compliance Test Plans for Failure Rate and Mean Time Between Failures Assuming Constant Failure Rate, Clause 6 - Procedures for Design and Application of Time Terminated Test Plans" or as suitable for determination testing according to IEC 605-4, "Equipment Reliability Testing - Part 4: Procedures for Determining Point Estimates and Confidence Limits for Equipment Reliability Determination Tests." Table 5-1 provides examples of the types of equipment considered.

TABLE 5-1: EXAMPLES OF EQUIPMENT AND ENVIRONMENTAL CONDITIONS COVERED BY IEC 605-3-1

TYPE OF EQUIPMENT	CONDITIONS
Small Office machines	Office
Bench Instruments	Laboratories or workshops
Small domestic equipment	Living rooms

The main objective of presenting preferred test conditions is to ensure that equipment with similar applications, although having different form, assembly and function are subject to the same test conditions. This also facilitates comparisons between equipment.

3.4 Limitations/Tailoring Recommendations

This document is applicable to indoor portable equipment operated only while in a stationary position. The mass of this equipment can not exceed 15 kg. Resulting test cycles will have a low degree of simulation.

In the case of a low degree of simulation, the test cycles are simplified. The reproducibility and repeatability of the tests are however maintained with respect to the fault modes and the reliability measure. It is assumed that these will be consistent on different occasions and in different laboratories when testing the same equipment. A low degree of simulation is used when failure consequences are less important, for example in television and radio entertainment. A cycle with a high degree of simulation is more complex and is closer to the actual conditions of use, but it is also more costly to perform by practical testing. A high degree of simulation is recommended when the outcome of the test is critical, for example when failure consequences are critical in terms of safety and economic loss, or are in conflict with regulations, as for environmental pollution. For further information concerning test cycles for other applications see IEC 605-3 and IEC 605-2.

The test cycle this document provides is not intended to replace tests for other purposes, such as qualification tests, functional performance tests and environmental tests.

Notice of Disclaimer: All material concerning this IEC document, except the document outline, was prepared by IIT Research Institute, operators of the RAC, under contract to the US Air Force Rome Laboratory. All such material is the sole responsibility of the IIT Research Institute.

CHAPTER 4: IEC 605 - 3-2 - EQUIPMENT RELIABILITY TESTING - PART 3: PREFERRED TEST CONDITIONS EQUIPMENT FOR STATIONARY USE IN WEATHERPROTECTED LOCATIONS - HIGH DEGREE OF SIMULATION*

*Identical to BSI Document BS 5760: Section 13.2: 1993 - Reliability of Systems, Equipment and Components: Guide to Reliability Test Conditions for Consumer Equipment: Conditions Providing a High Degree of Simulation for Equipment for Stationary Use in Weather Protected Locations.

This document is dated 1986 and contains 24 pages. Price: $43.00

4.1 Outline of Document•

4.2 Document Abstract

This document which provides preferred test conditions is applicable to equipment for stationary use in weatherprotected locations and in temperate climates. It is to be used in conjunction with IEC-605-1, *Equipment reliability testing. Part 1: General requirements* and other documents in this series. It contains preferred test conditions as referred to in sub-clause 8.4 of IEC 605-1. Whenever possible, test cycles should be chosen from among those given in this or other sections of IEC 605-3. For applications not covered by IEC 605 Part 3, appropriate test cycles should be designed using IEC 605-2, "Equipment Reliability Testing - Part 2: Design of Test Cycles."

4.3 Principal Features of the Document

Test cycles which have a high degree of simulation can be developed using this standard. Test cycles are sequences of different operating and environmental test conditions which are based upon actual conditions of use, as defined, for example, by the relevant product specification. The equipment undergoing reliability testing is normally subjected to repeated test cycles. The number of cycles will depend on the accumulated relevant test time, as required by the selected compliance test plan of IEC 605-7 or as suitable for determination testing according to IEC 605-4. Table 5-2 provides examples of the types of equipment considered.

TABLE 5-2: EXAMPLES OF EQUIPMENT AND ENVIRONMENTAL CONDITIONS COVERED BY IEC 605-3-2

TYPE OF EQUIPMENT	CONDITIONS
Telecommunications equipment	Telecommunications Center
Teletypewriter	Office
Mini and Micro-computers and peripherals	Office or home
Process and machine control equipment	Light industrial workshop or control room

The main objective of presenting preferred test conditions is to ensure that equipment with similar applications, although having different form, assembly and function are subject to the same test conditions. This facilitates comparisons between equipment.

4.4 Limitations/Tailoring Recommendations

This document is applicable to equipment for stationary use in weatherprotected locations and in temperate climates. Resulting test cycles will have a high degree of simulation.

A cycle with a high degree of simulation is more complex and is closer to the actual conditions of use, but it is also more costly to perform by practical testing. A high degree of simulation is recommended when the outcome of the test is critical, for example when failure consequences are critical in terms of safety and economic loss, or are in conflict with regulations, as for environmental pollution. Where failure consequences are less important, for example in television and radio entertainment, a low degree of simulation of conditions for use may be acceptable. For further information concerning test cycles for other applications see IEC 605-3 and IEC 605-2.

The test cycle this document provides is not intended to replace tests for other purposes, such as qualification tests, functional performance tests and environmental tests.

CHAPTER 5: IEC 605 - 3-3 - EQUIPMENT RELIABILITY TESTING - PART 3: PREFERRED TEST CONDITIONS SECTION 3: TEST CYCLE 3: EQUIPMENT FOR STATIONARY USE IN PARTIALLY WEATHERPROTECTED LOCATIONS - LOW DEGREE OF SIMULATION*

*Identical to BSI Document BS 5760: Section 13.3: 1993 - Reliability of Systems Equipment and Components: Guide to Reliability Test Conditions for Consumer Equipment: Conditions Providing a Low Degree of Simulation for Equipment for Stationary Use in Partially Weatherprotected Locations.

This document is dated 1992 and contains 33 pages. Price: $51.00

5.1 Outline of Document•

Foreword
Introduction
1. Scope
2. Normative references
3. Definitions
4. Applicability
   - 4.1 Type of equipment
   - 4.2 Operating conditions
   - 4.3 Environmental conditions
   - 4.4 Degree of simulation
   - 4.5 Examples
5. Basic assumptions underlying the severities
   - 5.1 Operating conditions
   - 5.2 Climatic conditions
   - 5.3 Mechanical conditions
   - 5.4 Other conditions
6. Pre-exposure tests
   - 6.1 Sand and dust test
   - 6.2 Salt mist test
7. Description of the test cycle
   - 7.1 Relevant period of equipment life covered by the test cycle
   - 7.2 Operating conditions
   - 7.3 Climatic conditions
   - 7.4 Interference by transient voltage
   - 7.5 Mechanical conditions
8. Relevant test time

5.2 Document Abstract

This document which provides preferred test conditions is applicable to equipment for stationary use in partially weatherprotected locations. It is to be used in conjunction with IEC-605-1, *Equipment reliability testing. Part 1: General requirements* and other documents in this series. It contains preferred test conditions as referred to in sub-clause 8.4 of IEC 605-1. Whenever possible, test cycles should be chosen from among those given in this or other sections of IEC 605-3. For applications not covered by IEC 605 Part 3, appropriate test cycles should be designed using IEC 605-2, "Equipment Reliability Testing - Part 2: Design of Test Cycles."

5.3 Principal Features of the Document

Test cycles which have a low degree of simulation can be developed using this standard. Test cycles are sequences of different operating and environmental test conditions which are based upon actual conditions of use, as defined, for example, by the relevant product specification. The equipment undergoing reliability testing is normally subjected to repeated test cycles. The number of cycles will depend on the accumulated relevant test time, as required by the selected compliance test plan of IEC 605-7 or as suitable for determination testing according to IEC 605-4. Table 5.3-1 provides examples of the types of equipment considered.

TABLE 5-3: EXAMPLES OF EQUIPMENT AND ENVIRONMENTAL CONDITIONS COVERED BY IEC 605-3-3

TYPE OF EQUIPMENT	CONDITIONS
Sheltered telecommunications equipment not intended for public use	Shelters or booths
Security systems, close circuit TV	Entrances of buildings or external walls of buildings

The main objective of presenting preferred test conditions is to ensure that equipment with similar applications, although having different form, assembly and function are subject to the same test conditions. This facilitates comparisons between equipment.

5.4 Limitations/Tailoring Recommendations

This document is applicable to equipment installed in partially weatherprotected locations in a climate covered by IEC 721-3-3, "Classification of Environmental Conditions - Part 3: Classification of Groups of Environmental Parameters and Their Severities - Stationary Use at Weatherprotected Locations." Resulting test cycles will have a low degree of simulation.

In the case of a low degree of simulation, the test cycles are simplified. The reproducibility and repeatability of the tests are however maintained with respect to the fault modes and the reliability measure. It is assumed that these will be consistent on different occasions and in different laboratories when testing the same equipment. A low degree of simulation is used when failure consequences are less important, for example in television and radio entertainment. A cycle with a high degree of simulation is more complex and is closer to the actual conditions of use, but it is also more costly to perform by practical testing. A high degree of simulation is recommended when the outcome of the test is critical, for example when failure consequences are critical in terms of safety and economic loss, or are in conflict with regulations, as for environmental pollution. For further information concerning test cycles for other applications see IEC 605-3 and IEC 605-2.

The test cycle this document provides is not intended to replace tests for other purposes, such as qualification tests, functional performance tests and environmental tests.

CHAPTER 6: IEC 605 - 3-4 - EQUIPMENT RELIABILITY TESTING - PART 3: PREFERRED TEST CONDITIONS SECTION 4: TEST CYCLE 4: EQUIPMENT FOR PORTABLE AND NON-STATIONARY USE - LOW DEGREE OF SIMULATION*

*Identical to BSI Document BS 5760: Section 13.4: 1993 - Reliability of Systems, Equipment and Components: Guide to Reliability Test Conditions for Consumer Equipment: Conditions Providing a Low Degree of Simulation for Equipment for Portable and Non-Stationary Use.

This document is dated 1992 and contains 37 pages. Price: $63.00

6.1 Outline of Document•

6.2 Document Abstract

This document which provides preferred test conditions is applicable to equipment for portable and non-stationary use. It is to be used in conjunction with IEC-605-1, *Equipment reliability testing. Part 1: General requirements* and other documents in this series. It contains preferred test conditions as referred to in sub-clause 8.4 of IEC 605-1. During exposure to the test conditions, the test items should be monitored according to sub-clause 9.1 of IEC 605-1. Whenever possible, test cycles should be chosen from among those given in this or other sections of IEC 605-3. For applications not covered by IEC 605 Part 3, appropriate test cycles should be designed using IEC 605-2, "Equipment Reliability Testing - Part 2: Design of Test Cycles."

6.3 Principal Features of the Document

This document provides preferred test conditions and is applicable to equipment for portable and non-stationary use. It is to be used in conjunction with IEC-605-1. Test cycles which have a low degree of simulation can be developed using this standard. Test cycles are sequences of different operating and environmental test conditions which are based upon actual conditions of use, as defined, for example, by the relevant product specification. The equipment undergoing reliability testing is normally subjected to repeated test cycles. The number of cycles will depend on the accumulated relevant test time, as required by the selected compliance test plan of IEC 605-7 or as suitable for determination testing according to IEC 605-4. Table 5-4 provides examples of the types of equipment considered.

TABLE 5-4: EXAMPLES OF EQUIPMENT COVERED BY IEC 605-3-4

TYPE OF EQUIPMENT
Field Service Instruments
Hand-held transceiver for professional use
Hand-held electrical megaphone
Remote control box for cranes, etc.

The main objective of presenting preferred test conditions is to ensure that equipment with similar applications, although having different form, assembly and function are subject to the same test conditions. This facilitates comparisons between equipment.

6.4 Limitations/Tailoring Recommendations

This document is applicable to equipment for portable and non-stationary use covered by IEC 721-3-7, "Classification of environmental conditions - Part 3: Classification of groups of environmental parameters and their severities." Resulting test cycles will have a low degree of simulation.

In the case of a low degree of simulation, the test cycles are simplified. The reproducibility and repeatability of the tests are however maintained with respect to the fault modes and the reliability measure. It is assumed that these will be consistent on different occasions and in different laboratories when testing the same equipment. A low degree of simulation is used when failure consequences are less important, for example in television and radio entertainment. A cycle with a high degree of simulation is more complex and is closer to the actual conditions of use, but it is also more costly to perform by practical testing. A high degree of simulation is recommended when the outcome of the test is critical, for example when failure consequences are critical in terms of safety and economic loss, or are in conflict with regulations, as for environmental pollution. For further information concerning test cycles for other applications see IEC 605-3 and IEC 605-2.

The test cycle provided by this document is not intended to replace tests for other purposes such as: qualification tests, functional performance tests, environmental tests and tests aiming at the verification of the ability to survive or function during extreme conditions of storage.

CHAPTER 7: IEC 605 - 4 - EQUIPMENT RELIABILITY TESTING - PART 4: PROCEDURES FOR DETERMINING POINT ESTIMATES AND CONFIDENCE LIMITS FOR EQUIPMENT RELIABILITY DETERMINATION TESTS

This document is dated 1986 and contains 61 pages. Price: $88.00

Amendment 1 is dated 1989 and contains 5 pages. Price: $21.00

7.1 Outline of Document*

7.2 Document Abstract

This standard provides recommended numerical and graphical methods for determining point estimates and confidence limits of reliability characteristics from equipment reliability determination tests. It is to be used in conjunction with IEC-605-1, *Equipment reliability testing. Part 1: General requirements* and other documents in this series. Amendment 1 is simply a one page replacement of Table II "χ^2 Distribution."

7.3 Principal Features of the Document

Recommended numerical and graphical methods for determining point estimates and confidence limits of reliability characteristics from equipment reliability determination tests is provided. The standard provides guidance applicable to data which follows a constant failure rate (follows an exponential distribution) or non-constant failure distribution. Non-constant failure rate distributions included in this standard include the Weibull and Normal.

The methods of calculation in this standard may be applied at any time or after any number of trials of the reliability testing. The more information that is available when the estimates and limits are determined, the higher is the precision obtained. Existing data from earlier tests or field observations may be acceptable, provided the data are sufficiently complete, well established and applicable to this situation.

7.4 Limitations/Tailoring Recommendations

This standard is not applicable to the pooling of data from different sources, for example, original data from tests under different conditions.

Whenever "time" is used in this standard, the variable may be replaced by distance, cycles or other quantities as may be appropriate.

Notice of Disclaimer: All material concerning this IEC document, except the document outline, was prepared by IIT Research Institute, operators of the RAC, under contract to the US Air Force Rome Laboratory. All such material is the sole responsibility of the IIT Research Institute.

CHAPTER 8: IEC 605 - 6 - EQUIPMENT RELIABILITY TESTING - PART 6: TESTS FOR THE VALIDITY OF A CONSTANT FAILURE RATE ASSUMPTION

The original document is dated 1986 and contains 16 pages.

Price: Original; $32.00 (35 CHF)

Amendment 1 is dated 1989 and contains 5 pages.

Price: Amendment; $21.00 (23 CHF)

8.1 Outline of Document*

Foreword

Preface

1. Scope
2. Introduction
3. Symbols and definitions
4. Accumulated relevant test time T* and parameter d
5. Validity test for a small number of failures
6. Validity test for large number of failures
7. Action to be taken if the assumption is rejected

8.2 Document Abstract

This document is to be used in conjunction with IEC-605-1, *Equipment reliability testing. Part 1: General requirements* and other documents in this series. It standardizes numerical methods for testing the statistical validity of the constant failure rate assumption underlying the methods used in Clause 5 of IEC Publication 605-4, "Equipment Reliability Testing - Part 4: Procedures for Determining Point Estimates and Confidence Limits for Equipment Reliability Determination Tests" and IEC Publication 605-7, "Equipment Reliability Testing - Part 7: Compliance Test Plans for Failure Rate and Mean Time Between Failures Assuming Constant Failure Rate." Recommendations are given for action to be taken if the assumption is rejected.

Amendment 1 corrects some typographical errors in the original document and replaces one table.

8.3 Principal Features of the Document

The validity of a constant failure rate can be determined by two tests provided in the document. Each test applies to different ranges of numbers of failures and becomes more sensitive as more failures are observed. These tests are the most generally accepted and statistically valid for testing for constant failure rate against any other (but unknown) distribution.

IEC 605 Part 6 provides information on computing the relevant test time for this particular test but most of the applicable information will be found in IEC 605 Parts 1, 4 and 7. Part 6 provides guidance to design the validity test for a small number and for a large number of failures, and to determine what action to take if the assumption is rejected. A Chi-squared distribution table is also given.

8.4 Limitations/Tailoring Recommendations

The tests in this part are designed to a level of significance of 10%, that is a 10% risk of rejecting the assumption even if it is true. If the validity test is required by the equipment contract or specification, then this risk should be considered together with the producer's risk in a reliability compliance test.

CHAPTER 9: IEC 605 - 7 - EQUIPMENT RELIABILITY TESTING PART 7: COMPLIANCE TEST PLANS FOR FAILURE RATE AND MEAN TIME BETWEEN FAILURES ASSUMING CONSTANT FAILURE RATE CLAUSE 6 - PROCEDURES FOR DESIGN AND APPLICATION OF TIME TERMINATED TEST PLANS

The original document is dated 1978 and contains 41 pages. Modification 1, Amendment 1: Clause 6 - Procedures for design and application of time terminated test plans is dated 1990 and contains 33 pages. Price: Original: $108.00 (82 CHF); Amendment: $63.00 (67 CHF)

9.1 Outline of Document*

Foreword
Preface
Clause
1. Scope
2. Relevant reliability characteristics
3. Statistical test plans and general test procedures
   3.1 Types of test plans
   3.2 General test procedure
   3.3 Calculation of accumulated relevant test time
4. Sequential test plans
   4.1 Sequential test plan characteristics
   4.2 Tables and graphs of the sequential test plans
5. Time/failure terminated test plans
   5.1 Time/failure terminated test plan characteristics
   5.2 Table and graphs of the time/failure terminated test plans

AMENDMENT 1

6. Procedures for design and application of time terminated test plans
   6.1 Scope
   6.2 Reference documents
   6.3 Other references
   6.4 Symbols
   6.5 Application
   6.6 Data to be recorded
   6.7 Procedure to determine D and C
   6.8 Procedures for various conditions and parameters
   6.9 Decision criteria
   6.10 Presentation of results

9.2 Document Abstract

This document is to be used in conjunction with IEC-605-1, *Equipment reliability testing. Part 1: General requirements* and other documents in this series. This publication provides tables and graphs of both sequential and time/failure terminated test plans to be used in designing a reliability compliance, or acceptance, test. Tables and graphs are presented for various values of consumer and producer risks (i.e., β and σ), required Mean Time Between Failure (MTBF) designated as (μ_o), and discrimination ratio(μ_o/μ_1), where μ_1 is an unacceptable value of MTBF. Information is also provided on expected test time, and probability of acceptance for various test plans. A total of 10 plans are provided for both sequential and time terminated testing.

9.3 Principal Features of the Document

This information is very much like what can be found in US MIL-STD-781, "Reliability Testing for Engineering Development, Qualification and Production." Amendment 1 to IEC 605-7 provides more detail on how to design a time terminated test plan. Both graphical and mathematical procedures are presented on determining risk, number of acceptable failures, discrimination ratio, relevant test time, total number of test items, and expected number of failures. These procedures give excellent guidance on designing a test plan to fit most situations.

9.4 Limitations/Tailoring Recommendations

The primary limitation to the procedures and plans presented are that they are only applicable to items that are assumed to have a constant failure rate. This publication should be used in conjunction with IEC-605-1 when compliance testing is a requirement, and the assumed failure distribution is exponential (i.e., constant failure rate assumption).

CHAPTER 10: IEC 1070 - COMPLIANCE TEST PROCEDURES FOR STEADY-STATE AVAILABILITY*

*Identical to BSI Document BS 5760: Section 10.3: 1993 - Reliability of Systems, Equipment and Components: Guide to Reliability Testing: Compliance Test Procedures for Steady-State Availability.

This document is dated 1991 and contains 52 pages. Price: $88.00

10.1 <u>Outline of Document</u>♦

ANNEXES

- A Tables A.1 to A.4
- B Numerical examples
- C Bibliography

10.2 Document Abstract

This standard specifies techniques for availability performance testing of frequently maintained items when the availability performance measure used is either steady-state availability or steady-state unavailability. It is to be used in conjunction with IEC-605-1, *Equipment reliability testing. Part 1: General requirements*, IEC 706-1 *Guide on maintainability of equipment - Part 1: Introduction requirements and maintainability programme* and other documents in these series.

10.3 Principal Features of the Document

Techniques to test the availability performance of frequently maintained items when the measure used for availability performance is either steady-state availability or steady-state unavailability are provided. The standard provides availability testing conditions, data which should be collected during testing, four separate compliance test plans, type of test reports required, and the information required by these test reports. Compliance test plans include:

- Test plan 1 - Fixed number of failures: This test is to be applied if up times are exponentially distributed and down times are modeled with a gamma distribution.

- Test plan 2 - Fixed time longer than 15 mean up times: This test plan may be applied if up times are exponentially distributed, down times are modeled with a gamma distribution, and the test time is longer than 15 multiples of mean up time, m_u. It is based on a normal distribution approximation of the steady state availability.

- Test plan 3 - Fixed time (U<0.05): This test plan may be applied when the ratio between m_d and m_u, i.e., m_d/m_u is less than 0.05

- Test plan 4 - Sequential test: This test is designed to have a duration that depends on the observed availability of the item during test. Each time a repair is completed, the decision rule gives guidance as to whether the test should be terminated or continued. The decision limits depend on the number of failures, *r*, that have occurred up to that instant of time.

Availability performance measures include, but are not limited to, instantaneous, mean, asymptotic, asymptotic mean and steady-state versions of availability, and mean accumulated down time. The preference for and application of these measures vary from one industry sector to another and from one product to another, depending on product application and end user needs.

10.4 Limitations/Tailoring Recommendations

This standard is applicable to compliance testing of the steady-state availability of items attaining only two states, up-state and down-state, under the following conditions:

1) One single repaired item.
2) All up times have exponential distribution.
3) Preventive maintenance time is not included in down time although it is recognized as having possible impact on availability performance.
4) All contributors to down time need to be explicitly stated in the requirement or test specification.
5) Very reliable items may require an extremely long time to determine compliance.
6) The compliance test procedures use the complementary measure steady-state unavailability.

With a highly reliable item, few or even zero failures may occur within a designated period of time. In such a case, there will be little or (possibly) zero quantitative information on the availability performance since there may be no repair actions. Parties (supplier and customer) applying this standard should agree on the decision to be made in such an eventuality. In general it is recommended that before the parties invoke this standard in a contract that they calculate, or simulate, the results to be obtained from the compliance test. In this way both parties will be knowledgeable regarding the risks they are facing.

CHAPTER 11: IEC 1123 - RELIABILITY TESTING COMPLIANCE TEST PLANS FOR SUCCESS RATIO*

*Identical to BSI Document BS 5760: Section 10.5: 1993 - Reliability of Systems, Equipment and Components: Guide to Reliability Testing: Compliance Test Plans for Success Rates.

This document is dated December, 1991 and contains 30 pages Price: $119.00 (105 CHF)

This standard replaces IEC 605-5 (1982) including Amendment 1 (1987)

11.1 Outline of Document•

Foreword

1. Scope
2. Normative references
3. Other references
4. Definitions
5. List of symbols
6. Application
7. General decision criteria
8. Truncated sequential test plans
9. Fixed trial/failure terminated test plans
10. Design of trial or failure terminated test plans Annexes
    - A. Additional information on sequential test plans
    - B. Design of trial or failure terminated test plans - Examples
    - C. Design of trial or failure terminated test plans - Mathematical procedures and formulas

11.2 Document Abstract

This standard specifies procedures for applying and preparing compliance test plans for success ratio or failure ratio. The procedures are based on the assumption that each trial is statistically independent. This document is to be used in conjunction with IEC 605-1, *Equipment reliability testing. Part 1: General requirements* and other documents in this series.

11.3 Principal Features of the Document

Detailed decision criteria for test plans are given for three types of tests: truncated sequential tests, fixed trial/failure terminated tests and designed trial/failure terminated tests. The test plans are based on the assumption that each trial is statistically independent and that the probability of success (or failure) is constant. The test plans are applicable to reused as well as non-reused (one-shot) items. Similar to information presented in MIL-HDBK-781, this standard provides graphs, tables and mathematical formulas needed to determine appropriate parameters for test plan development. Parameters to be determined include discrimination ratio (D), acceptable number of failures, and number of test trials or samples. Each test plan section (i.e., truncated sequential, fixed trial/failure terminated, and designed trial/failure terminated) assumes that acceptable levels of failure or success ratio are specified, or can be derived.

The terminology used may be somewhat unfamiliar to those familiar with MIL-HDBK-781. There are examples provided, however one example provided is for testing of MTTR requirements, and not reliability requirements. In this respect, the standard has been written in such a way as to be generic. That is, it makes no assumptions as to whether the test plan is for reliability, or some other system characteristic, despite the document title.

11.4 Limitations/Tailoring Recommendations

As noted, the test plans given in this standard are applicable to reused as well as non-reused (one-shot) items. Reused items may be repaired between successive trials, provided that the state and performance are the same at the start of all trials. For non-reused items, a separate test item is used for each trial. These test plans are based on the assumption that each trial is statistically independent and that the probability of success is constant. This standard is tailorable when used in conjunction with IEC 605-1, which is a tailorable document (see description of IEC 605-1 in this Section).

CHAPTER 12: IES - ENVIRONMENTAL STRESS SCREENING GUIDELINES FOR ASSEMBLIES

This document is dated March, 1990 and contains 70 pages. Price: $125.00

12.1 Outline of Document[1]

1. Introduction
   - 1.1 Background
   - 1.2 Scope

2. Program Management
   - 2.1 Environmental Stress Screening Concepts
   - 2.2 Definition of ESS
   - 2.3 Environmental Stress Screening Vs. Test
   - 2.4 Environmental Considerations
   - 2.5 ESS Non-Universality
   - 2.6 Considerations for a Dynamic Environmental Stress
   - 2.7 Characteristics of an Effective Environmental Stress Screen
   - 2.8 Failure-Free Requirement
   - 2.9 Value of Environmental Stress Screening
   - 2.10 Design of a Screen
   - 2.11 Factors to Consider in Determining ESS Level of Assembly

3. Random Vibration Stress Screening
   - 3.1 Vibration Fundamentals
   - 3.2 Is Rescreening Necessary?

4. Temperature Cycling Stress Screening
   - 4.1 Introduction
   - 4.2 Baseline Regimen
   - 4.3 Key Considerations

[1] Information reprinted from "Environmental Stress Screening Guidelines for Assemblies," copyrighted by the Institute for Environmental Sciences (IES).

5. Cost Effectiveness
   5.1 Introduction
   5.2 Spreadsheet Cost Analysis

Appendix A Environmental Stress Screen (ESS) Process Control
Appendix A1 Tailoring Environmental Stress Screens (ESS)
Appendix B Random Vibration Stress Screening Characteristics Development
Appendix B1 Vibration Survey Guidelines
Appendix C Temperature Cycling Stress Screening Characteristics Development
Appendix C1 Thermal Survey Guidelines
Appendix D Sample Environmental Stress Screening Statement of Work (SOW)
Appendix E References
Appendix F Acknowledgments

12.2 Document Abstract

This document reflects the latest thinking and experience of the technical and management community of both government and industry, and should provide a sound basis for the development and implementation of dynamic technically sound, cost beneficial ESS programs. It is comprehensive in nature, providing theoretical discussion, procedural information and data system requirements. It is similar to a handbook and should be utilized as a tool to aid in the development of a viable ESS program.

12.3 Principal Features of the Document

The guidance in this document focuses on assembly level stress screening. It makes the assumption that piece part quality levels meet program requirements. In this context the role of piece part quality is discussed. Also discussed is the effect of piece part quality on assembly yield with guidance on actions to be taken to ensure that piece part quality requirements are met.

Because random vibration and temperature cycling have proven to be the most common forms of ESS in terms of effective flaw precipitation, this document focuses on these forms of environmental stress.

12.4 Limitations/Tailoring Recommendations

Tailoring of an ESS program, as necessary, is an integral assumption of this document.

CHAPTER 13: IEC 1163 -1 - RELIABILITY STRESS SCREENING - PART 1: REPAIRABLE ITEMS MANUFACTURED IN LOTS

This document is dated 1995, and contains 161 pages. Price: $225.00

13.1 Outline of Document*

Foreword

Introduction

1. Scope
2. Normative references
3. Definitions
4. Symbols
5. General description
6. Planning
7. Pilot-production screening
8. Mature production screening

Annexes

- A Stress conditions: general information
- B Stress conditions: temperature
- C Stress conditions: vibration and bump
- D Stress conditions: humidity
- E Stress conditions: operational stress
- F Bimodal distributions - Weibull plotting and analysis
- G Evaluation of the failure-free period and the average screening duration
- H Worked-through example

13.2 Document Abstract

This standard describes particular methods to apply and optimize reliability stress screening processes. It is applicable for lots of repairable hardware items, in those cases where the items have an unacceptably low reliability in the early failure period, and when other methods, like reliability growth programs and quality control techniques, are not applicable. The reasons for using reliability stress screening may be time constraints or the nature of the deficiencies which the reliability stress screening is designed to catch.

13.3 Principal Features of the Document

The underlying principle assumed in this document is that the item has to survive a so-called "failure-free period," before it is released to the next step of production, or to the customer.

Three alternative verification methods for proper performance during this "failure-free period" are given:

- Alternative A uses two function checks, one before and one after the stress conditioning.
- Alternative B uses performance monitoring at discrete points in time with time intervals, preferably selected according to a logarithmic scale, so that the closest monitoring takes place in the beginning of the stress conditioning.
- Alternative C uses continuous monitoring during the entire stress conditioning. This is the preferred alternative.

The performance monitoring is of particular importance during pilot-production. During mature production, the performance monitoring under stress conditioning may be deleted, however, the two functional checks should not be eliminated. The extent and the details of the functional checking before, during and after the stress conditioning depend strongly on the nature and intended function of the items in question. This standard contains no guidance in that respect.

Guidance is given, in the annexes, regarding calculation of the "failure-free period" and selection of the optimal: stress conditions, stress duration, stress types and stress levels and number of cycles. These annexes form the major portion of the document.

13.4 Limitations/Tailoring Recommendations

The reliability stress screening processes in this standard apply to any stage of a series production of repairable items. The methods for setting up a process can be used during production planning, pilot-production, and well-established running production. A prerequisite for the application of the methods is that a certain level of flaws remaining in the outgoing item can be specified.

CHAPTER 14: IEC 1164 - RELIABILITY GROWTH - STATISTICAL TEST AND ESTIMATION METHODS

This document is dated 1995 and contains 61 pages. Price: $120.00

14.1 Outline of Document[♦]

14.2 Document Abstract

This standard gives models and numerical methods for reliability growth assessments based on system failure data from a reliability improvement program. The assessment procedures include tests for growth, estimation and confidence intervals for system reliability, and goodness-of-fit tests.

14.3 Principal Features of the Document

This standard describes the Non-Homogeneous Poisson Process (NHPP) power law reliability growth model and its related projection model and gives step-by-step directions for their use. It is used in conjunction with IEC 1014, "Programmes for Reliability Growth" and provides procedures to estimate some or all of the quantities listed in clause 9 of IEC 1014 (see Section 9 for a description).

An input is required consisting of a data set of accumulated test times at which relevant failures occurred, or were observed, for a single system, and the time of termination of the test, if different from the time of the final failure. It is assumed that the collection of data as input for the model begins after the completion of any preliminary tests, such as environmental stress screening, intended to stabilize the system's initial failure intensity. Model parameters estimated from previous results may be used to plan and predict the course of future reliability growth programs, if the conditions are similar.

Appendix A gives four worked-out numerical examples. Appendix B gives additional background on the development of these models.

14.4 Limitations/Tailoring Recommendations

Some of the procedures may require computer programs, but these are not unduly complex. This standard presents algorithms for which computer programs should be easy to construct.

CHAPTER 15: DSTAN 00-43 (PART 1)/ISSUE 1 RELIABILITY AND MAINTAINABILITY ASSURANCE ACTIVITY PART 1: IN-SERVICE RELIABILITY DEMONSTRATION

The original document is dated 29 January 1993 and contains 39 pages. Price: $43.00

15.1 Document Outline*

Section One. General
- 0 Introduction
- 1 Scope
- 2 Warning
- 3 Related document
- 4 Definitions

Section Two. Consideration
- 5 Aim
- 6 Background
- 7 Benefits
- 8 Constraints

Section Three. Management
- 9 General
- 10 Responsibilities

Section Four. Contractual Application
- 11 Invitation to tender (ITT)
- 12 Contractual agreement
- 13 Multiple contractors
- 14 Purchaser and contractor risks
- 15 Corrective action

Section Five. ISRDs, Trail and Other Test Methods
- 16 General
- 17 Pre-Delivery trials of production equipment
- 18 Peacetime usage
- 19 Combination with other methods

Section Six. Demonstration Plans
- 20 General
- 21 Statistical plans
- 22 Confidence statements
- 23 Selection of samples

15.2 Document Abstract

Part One of this document covers the goal and general procedures for In-Service Reliability Demonstrations (ISRDs). This demonstration is used by the project manager to assess the reliability of a finished equipment in a real environment and to demonstrate compliance with the specified reliability. The ISRD is the final test for the equipment. Experience from completed ISRDs has shown the need for detailed guidance for both MOD and Industry and this document stands for this purpose.

15.3 Principal Features

This document is for guidance only. Its purpose is to inform MOD project managers on the requirements for the ISRD and how it should be formulated. For the

industry, this document explains the implication of an ISRD as a part of the contract. This document gives some information to the project manger concerning whether or not to include an ISRD as part of the procurement strategy. It provides guidance on the action to be taken for ISRDs at the specification, invitation to tender and final contract stages.

The purpose of Section Two is to describe general factors to be discussed by the project manager and the sponsor on the ISRD. Section Three talks about the relationship between the agencies involved in an ISRD. Usually, three agencies will be involved: the MOD, the user and the contractor. Each will have responsibility for implementing specific elements of the ISRD and for this reason it is very important that the three agencies be well coordinated.

Section Four explains that the ISRD needs to be declared as part of the contract and there are essential elements and information which may considerably affect the responses from the contractor. Section Five deals with the case where a full demonstration of reliability may be neither practical nor necessary, but for which some alternative demonstration may be required. So some combination of methods can be used. Sections Six and Seven deal with the demonstration plans. This includes how to choose a plan, whether it should be fixed length or sequential, what precision is required with regard to the consumer risk and the manufacturer risk, and how to select a sample. This guidance is qualitative in nature, however, as no figures or mathematical rules are provided to help decide which statistical test to choose. Some information is provided on how to classify any failure during the test and how to deal with special cases.

Section Eight of this document provides information on analyzing the ISRD test results, gathering the data from every different unit and which procedures to use in recording the data.

15.4 Limitations/Tailoring Recommendations

This part of DSTAN 00-43 is for guidance only. Consequently this document will not be called up in a contract, rather a directive based on this part of the standard can become part of the contract. The information provided within this document is aimed at demonstration testing of production standard equipment. It is akin to what is known as a Production Reliability Acceptance Test (PRAT) within the US DoD environment. While it is a guidance document, it can become part of a contract by reference, and

therefore the methods provided must be tailored to fit the needs and limitations of the product to which it is applied.

SECTION 6
MAINTAINABILITY

PREFACE

Maintainability can be defined as the relative ease and economy of time and resources with which an item can be retained in or restored to a specified condition when maintenance is performed by personnel having specified skill levels, using prescribed procedures and resources, at each prescribed level of maintenance and repair. Documents dealing with maintainability should be used to specify and improve on the inherent maintainability aspects of a product. This includes application of practices and principles such as allocation, modelling, test analyze and fix, etc. A subset of maintainability is testability. Testability has become an important aspect in maintenance and is being addressed more and more in both commercial and military applications. The documents reviewed in this section cover a wide range of maintainability issues including requirements and program plan development, data collection and analysis, maintenance support planning, and diagnostic testing.

The US Military standards and handbooks that fall under the category of maintainability, but have not been reviewed as part of this effort are listed below. The current status of these documents under DoD Acquisition Reform can be found in Section 11, Chapter 5.

- MIL-STD-470 Maintainability Programs for Systems and Equipment
- MIL-STD-471 Maintainability Verification/Demonstration/Evaluation
- MIL-STD-2084 General Requirements for Maintainability
- MIL-STD-2165 Testability Program for Electronic Systems and Equipments (see Chapter 3 of Section 11)

Chapter 1 IEC **706 - 1**

Guide on Maintainability of Equipment - Part 1: Sections One, Two and Three: Introduction, Requirements and Maintainability Programme, First Edition, 1982

Chapter 2 IEC **706 - 2**

Guide on Maintainability of Equipment - Part 2: Section Five: Maintainability Studies During the Design Phase, First Edition, 1992

Chapter 3 IEC **706 - 3**

Guide on Maintainability of Equipment - Part 3: Sections Six and Seven: Verification and Collection, Analysis and Presentation of Data, First Edition, 1987

Chapter 4 IEC **706 - 4**

Guide on Maintainability of Equipment - Part 4: Section 8: Maintenance and Maintenance Support Planning, First Edition, 1992

Chapter 5 IEC **706 - 5**

Guide on Maintainability of Equipment - Part 5: Section 4: Diagnostic Testing, First Edition, 1994

Chapter 6 IEC **706 - 6**

Guide on Maintainability of Equipment - Part 6: Section 9: Statistical Methods in Maintainability Evaluation, First Edition, 1994

Chapter 7 SAE **HS-2600**

SAE Maintainability, Reparability, and Serviceability Standards Manual, September, 1993

Chapter 8 NASA **NHB 5300.4 (1E)**

Reliability, Maintainability, and Quality Assurance Publication, Maintainability Program Requirements for Space System, March 1982

Chapter 9 DSTAN **00-25** (Part 11) Issue 1 - Human Factors for Designers of Equipment: Part 11: Design for Maintainability

CHAPTER 1: IEC 706 - 1 - GUIDE ON MAINTAINABILITY OF EQUIPMENT - PART 1: SECTIONS ONE, TWO AND THREE: INTRODUCTION, REQUIREMENTS AND MAINTAINABILITY PROGRAMME*

*Identical to BSI Document BS 6548: Part 1: 1984 - Maintainability of Equipment Part 1: Guide to Specifying and Contracting for Maintainability (Price $143.00, 16 pages)

This document is dated 1982 and contains 39 pages. Price: $69.00

1.1 Outline of Document•

Foreword

Preface

1. Scope

Section One - Introduction to Maintainability

2. Concept of maintainability
3. General Approach
4. Maintainability activities
   - 4.1 Planning phase
   - 4.2 Acquisition phase
   - 4.3 Use Phase

Section Two - Maintainability Requirements in Specifications and Contracts

5. Introduction
6. Maintainability requirements
   - 6.1 Maintainability characteristics
   - 6.2 Constraints
   - 6.3 Program requirements
   - 6.4 Engineering support planning
7. Verification

Section Three - Maintainability Program

8. General
   - 8.1 Introduction
   - 8.2 The purpose of a maintainability program
   - 8.3 General characteristics of a maintainability program
   - 8.4 Integration of the maintainability program with other activities
   - 8.5 Qualitative and quantitative measurement of maintainability

1.2 Document Abstract

The guidance on maintainability of equipment is broken out into six separate publications. This publication contains Sections One, Two and Three of the overall guide. Section Five of the guide is found in IEC 706 - 2, Sections Six and Seven are found in IEC 706 - 3. Section Eight is in IEC 706 - 4, Section Four is in IEC 706 - 5, and Section Nine is in IEC 706 - 6.

The purpose of the guide is to make recommendations for the standardization of maintainability practices, and to stimulate ideas in the maintainability field. Organizations acquiring items will find the guide useful in assisting them in defining maintainability requirements and associated programs. Item suppliers will benefit from use of the guide, gaining an understanding of the requirements for achieving and verifying maintainability objectives.

1.3 Principal Features of the Document

Sections One and Two of this guide provide cursory descriptions of what maintainability is, and the elements important to defining maintainability specifications and requirements. Section Three, Maintainability Program, provides an excellent outline and description of what elements should be considered as part of an overall maintainability program plan. This section covers all phases of program development, and outlines information to be provided by the contractor and by the customer. References to the remaining sections are made at appropriate places for further guidance on a particular subject. However, no reference is made to Section Four of the guide, which is Test and Diagnostic Procedures. Titles for all sections of the guide are as follows:.

Section One	-	Introduction to maintainability
Section Two	-	Maintainability requirements in specifications and contracts
Section Three	-	Maintainability program
Section Four	-	Test and diagnostic procedures
Section Five	-	Maintainability design studies
Section Six	-	Maintainability verification
Section Seven	-	Collection, analysis and presentation of data related to maintainability

1.4 Limitations/Tailoring Recommendations

This document and all other sections of IEC 706, "Guide on Maintainability" are presented as a guide and should therefore be used as such. Parts of Section One state that the customer should define which tasks need to be performed to meet requirements. However, this goes against current trends, which are to define requirements, but leave it up to the contractor to determine how best to meet them. (Note that this document is dated 1982.)

CHAPTER 2: IEC 706 - 2 - GUIDE ON MAINTAINABILITY OF EQUIPMENT - PART 2: SECTION FIVE: MAINTAINABILITY STUDIES DURING THE DESIGN PHASE*

*Identical to BSI Document BS 6548: Part 2: 1992 - Maintainability of Equipment: Guide to Maintainability Studies During the Design Phase.

This document is dated 1992 and contains 39 pages. Price: $69.00

2.1 Outline of Document♦

2.2 Document Abstract

This section of IEC 706, "Guide on Maintainability of Equipment," outlines maintainability studies in the preliminary and detailed design phases and their relationships to other maintainability and maintenance support tasks, which are described in other sections of the guide.

2.3 Principal Features of the Document

The document provides a good outline for management on the types of maintainability design analysis tasks that should be considered during the design phase of a program. A list of detailed tasks including maintainability definition, preliminary maintenance support analysis, maintenance support definition, detailed maintainability analysis via prediction, FMEAs, ease of maintenance studies, etc., and preparation for maintainability verification are provided. A graphic on where maintainability tasking falls within the product life cycle is also provided. The graphic is further divided into System Considerations, Maintainability Considerations, and Maintenance Support Considerations. More detailed overviews are provided on specific maintainability analysis techniques, including FMEAs, allocation, block diagrams, predictions and trade-off studies. Under design support, the following three tasks are outlined: liaison, design criteria and check-lists, and design reviews.

2.4 Limitations/Tailoring Recommendations

This section of IEC 706 provides an excellent overview for individuals who are interested in developing a maintainability program in support of the design phase. Maturity of technology, complexity and risks involved in not meeting maintainability requirements should be considered when selecting the tasks for a particular application. The aim should be to select a minimum number of tasks to satisfy requirements.

CHAPTER 3: IEC 706 - 3 - GUIDE ON MAINTAINABILITY OF EQUIPMENT - PART 3: SECTIONS SIX AND SEVEN: VERIFICATION AND COLLECTION, ANALYSIS AND PRESENTATION OF DATA*

*Identical to BSI Document BS 6548: Part 3: 1992 - Maintainability of Equipment: Guide to the Maintainability, Verification, and the Collection, Analysis and Presentation of Maintainability Data.

This document is dated 1987 and contains 50 pages. Price: $84.00

3.1 Outline of Document♦

Foreword
Preface
1. Scope

Section Six - Maintainability Verification

2. Definitions
3. Objective
4. Maintenance support concepts influencing maintainability verification
5. Verification
    - 5.1 General
    - 5.2 Verification concepts
    - 5.3 Elements of the verification procedure

Section Seven - Collection, Analysis and Presentation of Data Related to Maintainability

6. Introduction
7. Definition of terms
8. Maintenance concept
9. Data sources
    - 9.1 Historical data
    - 9.2 Item design/manufacturing data
    - 9.3 Item demonstration and field data
10. Analysis procedures
    - 10.1 Data editing
    - 10.2 Statistical distribution analysis
    - 10.3 Parameter computation
11. Data presentation
    - 11.1 Corrective maintenance
    - 11.2 Preventive maintenance
    - 11.3 Maintenance support data

Table I	Active repair task data summary form
Table II	Active repair time summary form
Table III	Preventive maintenance summary
Appendix A	Maintainability demonstration procedures

3.2 Document Abstract

This guide on maintainability makes recommendations for the standardization of maintainability practices and stimulates ideas in the maintainability field. It assists users in defining maintainability requirements and their associated programs. The guide gives suppliers an understanding of the necessity of achieving and verifying maintainability objectives.

Maintainability verification is a process of assessing the results of maintainability experience. This assessment can begin as soon as data and results are available and may continue throughout the project and extend into field use.

3.3 Principal Features of the Document

This guide contains two sections which address different but related topics. The first topic is Maintainability Verification and the second is the Collection, Analysis and Presentation of Data.

The first section describes the various aspects of verification necessary to ensure that the specified maintainability requirements have been met, and it provides suitable procedures and test methods.

The objective is to verify that both qualitative and quantitative maintainability requirements have been met within the specified performance limitations. This includes verification that the defined maintenance activity has restored the equipment to the specified performance level. Verification is applicable to hardware, software and maintenance facilities. Guidance is given regarding the specific test methods to be applied. This selection will depend, of course, on the parameters which are either specified , or are meaningful for a potential user of the item.

The second section provides an overview of the considerations to be addressed in the collection, analysis and presentation of maintainability-related data.

Maintainability-related data are required at several points during the item life cycle for evaluation purposes. Collection, analysis and presentation of maintainability-related data may be required during and at the completion of design, and during item production and operation. Such data are typically submitted by the item supplier to the intended user in a maintainability data report which presents the data along with the supporting rationale.

Key maintainability characteristics of concern are corrective and preventive active maintenance downtime and man-hours. Maintenance support information should also be provided defining the personnel and facilities required. In the presentation of maintainability-related data, it is important to consider the maintenance concept, the definition of terms, the description of data sources, the analysis procedures and the method for displaying the data. The suggested scope for each of these factors is outlined in this section of the guide.

The two topics, verification and data collection and analysis, are integrally related and combined into a single volume because maintainability verification is understood to be a continuous process of generating, collecting and evaluating maintainability-related data as they become available in the course of project development, and comparing the results with the specified requirements.

3.4 Limitations/Tailoring Recommendations

Maintainability verification as such should be a mandatory part of any maintainability program. However, methods of maintainability verification differ according to the respective program phase and each individual case requires that appropriate methods to be carefully selected in order to ensure overall cost-effectiveness. The maintainability verification methods to be used should be specified by the customer or selected by the contractor and described in the maintainability program plan (see IEC 706-1, Section Three, "Introduction, Requirements and Maintainability Programme").

CHAPTER 4: IEC 706 - 4 - GUIDE ON MAINTAINABILITY OF EQUIPMENT - PART 4: SECTION 8: MAINTENANCE AND MAINTENANCE SUPPORT PLANNING*

*Identical to BSI Document BS 6548: Part 4: 1995 - Maintainability of Equipment: Guide to the Planning of Maintenance and Maintenance Support.

This document is dated 1992 and contains 36 pages. Price: $98.00

4.1 Outline of Document•

4.2 Document Abstract

This section of IEC 706 "Guide on Maintainability of Equipment" describes the tasks required for planning of maintenance and maintenance support. These tasks should be performed during the system acquisition phase in order to meet the availability objectives in the operational phase. The interfaces between reliability, maintainability and the maintenance support planning program and their tasks are also described.

4.3 Principal Features of the Document

Achieving an item's maintainability objectives during the operational phase is largely dependent on appropriate maintenance and maintenance support procedures, and the provision of adequate maintenance resources. The specific tasks addressed in IEC 706-4 are: a) the maintenance concept, b) maintenance support planning and c) maintenance support analysis. Maintenance and maintenance support resources have a major influence on the life cycle costs (LCC) of an item. This must be considered throughout the planning process. Maintainability and maintenance support planning tasks should therefore be closely coordinated and performed concurrently.

4.4 Limitations/Tailoring Recommendations

The extent and depth of performing the various tasks will vary greatly with application. Maturity of technology, complexity and risks involved in not meeting operational requirements should be considered when selecting the tasks for a particular application. The aim should be to select a minimum number of tasks to satisfy the need. Users may have their own maintenance support organization and systems/equipment should be compatible. Such constraints should be stated in the maintainability requirements.

CHAPTER 5: IEC 706 - 5 - GUIDE ON MAINTAINABILITY OF EQUIPMENT - PART 5: SECTION 4: DIAGNOSTIC TESTING*

*Identical to BSI Document BS 6548: Part 5: 1995 - Maintainability of Equipment: Guide to Diagnostic Testing.

This document is dated 1994 and contains 53 pages. Price: $108.00

5.1 Outline of Document♦

5.2 Document Abstract

This document is designed to provide guidance for the early consideration of testability aspects in design and development, and to assist in determining effective test procedures as an integral part of operation and maintenance. This section is applicable to all categories of equipment, although many of the techniques described are clearly more applicable to the electrical and electronic fields.

5.3 Principal Features of the Document

This document does an excellent job of showing the importance to maintainability of diagnostics, and how diagnostics affect and relate to life cycle costs, availability, and operational and maintenance concepts. Clear explanations are given for the types of diagnostic testing. The document also does a good job of explaining the types of data associated with diagnostics. This data is categorized as primary data, defined as data which is measured physically to determine equipment status (usually binary or analog), including stimulus data applied to a unit under test (UUT), and secondary data, which is data used to quantify diagnostic effectiveness. Examples of secondary data include fault coverage, fault resolution and fault localization time. The document also provides excellent guidance on trade off considerations when choosing diagnostic approaches, as well as a list of considerations for testability requirements development.

5.4 Limitations/Tailoring Recommendations

The document is best used as a guidance document for diagnostic design considerations. Although it does provide guidance on development of testability requirements, other standards and handbooks may prove to be more useful such as US MIL-HDBK-2165 "Testability Program for Electronic Systems and Equipment." The information contained within the document is best utilized in the early phases of program development, especially in the requirements development and concept exploration phases.

Notice of Disclaimer: All material concerning this IEC document, except the document outline, was prepared by IIT Research Institute, operators of the RAC, under contract to the US Air Force Rome Laboratory. All such material is the sole responsibility of the IIT Research Institute.

CHAPTER 6: IEC 706 - 6 - GUIDE ON MAINTAINABILITY OF EQUIPMENT - PART 6: SECTION 9: STATISTICAL METHODS IN MAINTAINABILITY EVALUATION

This document is dated 1994 and contains 45 pages. Price: $94.00

6.1 Outline of Document*

6.2 Document Abstract

This part of IEC 706 is issued as section 9 of the guide on maintainability of equipment. It specifies techniques covering some quantitative aspects of maintainability engineering in various phases of the system life cycle. It is applicable to the tasks of maintainability allocation, maintainability demonstration and maintainability data evaluation, as described in sections Five, Six and Seven of the guide (IEC 706-2 and 706-3).

6.3 Principal Features of the Document

The body of this document is extremely concise. The major useful portions of the document are Annex A, B and C.

The document provides mathematical methods, in Annex A, for determining maintainability allocations, to the LRU level, for maximum active corrective maintenance time, based on a log-normal distribution of maintenance times, and known values for the maximum active corrective maintenance time, the mean active corrective maintenance time, and LRU failure rates. An example is provided on allocation.

Annex B provides information on determining accept/reject values for maintainability demonstration testing. Test methods, in the form of tested hypotheses, and required sample sizes and decision criteria, are provided for testing on the mean active corrective maintenance time, fractiles, and active corrective maintenance time above a specified value. Information is given on equations for determining required sample sizes and the assumptions for each method.

Annex C provides information on determining the best fit distribution for maintenance times using the Kolmogorov-Smirnov distribution test.

6.4 Limitations/Tailoring Recommendations

The information in this section of IEC 706 is supplemental to the sections listed in the abstract (sections five, six and seven). This publication should not be used as a stand alone document. The information provided is in addition to more detailed references available on the three subject areas: maintainability allocation, demonstration and distribution testing.

CHAPTER 7: SAE HS-2600 - MAINTAINABILITY, REPAIRABILITY, AND SERVICEABILITY STANDARDS MANUAL

This document is dated September, 1993 and contains 195 pages. Price: $69.00

7.1 Outline of Document

1. Introduction
2. SAE Surface Vehicle Standards, Recommended Practices, and Information Reports
   - 2.1 Maintainability, Reparability, and Service Reports
   - 2.2 Vehicle and Component Identification Number Reports
3. Key Word Index
4. Bibliography of SAE Special Publications and Technical Papers
5. Bibliography of SAE Aerospace Reports on Related Subjects

7.2 Document Abstract

There has been increasing national and international awareness and concern about the limited nature of the world's natural resources, especially those used in the production of automotive products. This concern has been translated into conservation measures undertaken by the public, industry and government. Many of these measures have been directed at more efficient use and reuse of both raw and processed materials. In response the SAE has greatly expanded established efforts, and initiated new efforts, for the development of technical reports pertaining to the maintainability, reparability, and serviceability of motor vehicles.

7.3 Principal Features of the Document

Section 1 is introductory in nature. Sections 2 and 5 of this manual provide compendia of reports produced by specialized committees functioning under the SAE Technical Board. Section 3 contains a key word index. Section 4 also includes a bibliography of other maintainability, reparability and serviceability reports and compilations which have been published by the Society.

7.4 Limitations/Tailoring Recommendations

Effective use of this document is obviously limited to the automotive and related communities.

CHAPTER 8: NASA NHB 5300.4 (1E) - RELIABILITY, MAINTAINABILITY, AND QUALITY ASSURANCE PUBLICATION, MAINTAINABILITY PROGRAM REQUIREMENTS FOR SPACE SYSTEM

This document is dated March, 1987 and contains 30 pages. Price: $17.50

8.1 Outline of Document

Preface

Chapter 1: Introduction
- Scope
- Approach
- Relation to other contract requirements
- Actions and prerogatives of the government
- Relationship between maintainability requirements/activities and program phases
- Maintainability program data requirements
- Glossary of terms

Chapter 2: Maintainability Program Management
- Organization
- Maintainability program plan
- Maintainability program plan control
- Reports
- Maintainability training
- Subcontractor and supplier control
- Maintainability of government-furnished property (GFP)

Chapter 3: Maintainability Engineering
- General
- Maintainability concept
- Maintainability plan
- Maintainability design criteria
- Engineering design analysis
- Tool requirements
- ORU Placement
- Software Maintainability
- Problem reporting and corrective action

Chapter 4: Maintainability Analysis
- General
- Quantitative Maintainability requirements
- Maintainability models
- Maintainability allocation
- Maintainability prediction
- Failure mode and effects analysis (FMEA) - maintainability information

Preventive maintenance analysis
Emergency maintenance analysis
Spares requirements analysis

Chapter 5: Maintainability Assessment, Demonstration, and Data Collection
General
Maintainability assessment
Maintainability demonstration
Maintainability demonstration documentation
Maintainability inputs to readiness reviews
Maintainability evaluation reviews
Maintainability data collection
Maintainability acceptance

Appendices:
Appendix A: Relationship between Maintainability Requirements/ Activities and Program Phases
Appendix B: Recommended List of Contractor-Generated Maintainability Documents
Appendix C: Glossary of Terms

8.2 Document Abstract

This document prescribes the maintainability program requirements for use on NASA in-house projects and for NASA contracts. These requirements are applicable to manned and unmanned space programs where on-orbit maintenance is planned and will be invoked to the extent necessary by the NASA procuring activity in the statement of work and/or contract.

8.3 Principal Features of the Document

This document provides general requirements for NASA programs to: a) Design maintainability into all systems where maintenance is a factor to system operation and mission success, and b) ensure that maintainability characteristics are developed through a systems engineering approach. It represents a basic set of requirements that will achieve a design for maintenance.

The scope and approach associated with a maintainability program is presented. Planning and management is discussed which includes the development of a maintainability program plan for each program phase and the proper controls to assure that contractual requirements are met. A general overview of this process is given. The process associated with establishing design requirements and the engineering tasks

associated with the systems engineering process are also outlined. These tasks focus primarily on the form, fit and function of a design yet allow for practical and economical maintenance within the established program and mission constraints. Maintainability analyses and the assessment, demonstration and the collection of data associated with a maintainability program are also defined.

8.4 Limitations/Tailoring Recommendations

Maintainability requirements may differ in phasing and task emphasis from requirements provided by other specifications due to the research and development nature of NASA where:

- Quantities produced are generally small. Therefore the depth of logistics support typical of many programs is not warranted.
- The cost of excessive maintenance is very high due to the logistics problems associated with the space environment.
- The ability to provide timely maintenance often involves safety considerations for manned space flight applications.

Maintainability program requirements defined by this specification are applicable to manned and unmanned space programs in the following phases of system development:

- Preliminary analysis
- Definition
- Design
- Development/operation

The preliminary analysis and definition phases definitize the design requirements for reliability. The design and development/operation phases include engineering and analytical tasks that result in a system design that will achieve desired maintainability characteristics.

CHAPTER 9: DEF 00-25 (PART 11)/ISSUE 1 - HUMAN FACTORS FOR DESIGNERS OF EQUIPMENT: PART 11: DESIGN FOR MAINTAINABILITY

This document is dated 31 August, 1988, and contains 15 pages. Price: $36.00

9.1 Document Outline*

9.2 Document Abstract

Part 11 of a 12 part series covering human factors for design, this part is dedicated to human factors issues for maintainability. The information presented is aimed at providing the designer with insight to human factors considerations during the pre-design requirements phase of system development.

9.3 Principal Features of the Document

Aside from information presented on management issues, the primary details are provided in Section 7, Designing for Human Maintenance. Within this section, information in the form of checklists and questions are presented for consideration. Specifically, the following categories are covered: unit attachment, unit identification, unit handling/portability, use and positioning of handles for lifting, unit lifting requirements, unit case structure/design, maintenance tooling and test equipment, use of access fasteners, access to components, component lubrications, servicing of live/working systems, and maintenance design checklist for human factors.

Tables and figures are also presented for the following: unit attachment via runners, unit identification preferences, handle clearance dimensions, recommended height/weight lift limits, case design, maintenance access dimensions, and a checklist for maintenance design factors relating to human factors. In addition to the information described, environmental conditions are also discussed as they affect specific categories, such as the use of a particular type of handle, amount of lighting required, size of control knobs, etc.

9.4 Limitations/Tailoring Recommendations

There are no real major limitations on the use of this standard, although it is aimed primarily at the requirements development stage. It could easily be used to develop an initial design guide for human factors for maintainability. Tailoring would be as required for the specific type of unit being designed, its usage environment, and maintenance scenarios. The question/checklist format of the information presented makes such tailoring very easy.

SECTION 7
DATA COLLECTION AND PARTS INFORMATION

PREFACE

The collection and analysis of data relating to reliability, maintainability and availability remains one of the most important functions to designing in and improving the R, M & A characteristics of today's systems. Data collection programs need to be instilled both during product development, such as the establishment of a Failure Reporting, Analysis and Corrective Action System (FRACAS), and during the useful life of the product. Field data is important to track operational performance, and to determine where and how improvements can be made in future generations. The documents summarized in this section include guidance on the establishment and content for a field data collection system, and on the presentation and documentation of data collected on electronic components.

In addition to the importance that data represents to a successful R, M & A program, the role that the reliability of parts plays to the overall system reliability continues to be a major factor. With more emphasis on the use of commercial parts in today's military systems, proper specification and control of those and other parts is now an important aspect in product development. Controlling and "catching" reliability problems at the part level has and continues to be less costly to correct, than if the same problems occur downstream in the development process. Therefore, it is important to choose documents that provide a standard, logical approach to the testing, selection and control of parts. The one document summarized in this section that deals with parts specification is IEC 409, "Guide for the Inclusion of Reliability Clauses into Specifications for Components (or Parts) for Electronic Equipment, Second Edition, 1981." The description for this document can be found in Chapter 3 of this section.

The US military standards and specifications that fall under the category of data collection and parts information, but have not been reviewed as part of this effort are listed below. The current status of these documents under DoD Acquisition Reform can be found in Section 11, Chapter 6.

- MIL-STD-690 Failure Rate Sampling Plans and Procedures
- MIL-STD-757 Reliability Evaluation for Demonstration Data

- MIL-STD-790 Reliability Assurance Program for Electronic Parts Specifications
- MIL-STD-883 Test Methods and Procedures for Microelectronics
- MIL-STD-965 Parts Control Program
- MIL-STD-1840 Automated Interchange of Technical Information
- MIL-M-38510 General Specification for Microcircuits
- MIL-H-38534 General Specification for Hybrid Microcircuits
- MIL-I-38535 General Specification for Integrated Circuits (Microcircuits) Manufacturing

Chapter 1 IEC 300 - 3-2
Dependability Management - Part 3: Application Guide - Section 2: Collection of Dependability Data from the Field, First Edition, 1993 (Replaces IEC 362)

Chapter 2 IEC 319
Presentation of Reliability Data on Electronic Components (or Parts), Second Edition, 1978

Chapter 3 IEC 409
Guide for the Inclusion of Reliability Clauses into Specifications for Components (or Parts) for Electronic Equipment, Second Edition, 1981

Chapter 4 DSTAN 00-44 (Part 1)/Issue 1 - Reliability and Maintainability Data Collection and Classification, Part 1: Maintenance Data and Defect Reporting in the Royal Navy, the Army and the Royal Air Force

Chapter 5 DSTAN 00-44 (Part 2)/Issue 1 - Reliability and Maintainability Data Collection and Classification, Part 2: Data Classification and Incident Sentencing - General

CHAPTER 1: IEC 300 - 3-2 - DEPENDABILITY MANAGEMENT - PART 3: APPLICATION GUIDE - SECTION 2: COLLECTION OF DEPENDABILITY DATA FROM THE FIELD* (REPLACES IEC 362, DATED 1971)*

*Identical to BSI Document BS 5760: Part 11: 1994 - Reliability of Systems, Equipment and Components: Collection of Reliability, Availability, Maintainability and Maintenance Support Data from the Field.

This document is dated 1993 and contains 29 pages. Price: $56.00

1.1 Outline of Document♦

1.2 Document Abstract

This section of IEC 300-3 provides guidelines for the collection of data relating to reliability, maintainability, availability and maintenance support performance of items operating in the field. It deals in general terms with the practical aspects of data collection and presentation and briefly explores the related topics of data analysis and presentation of results.

1.3 Principal Features of the Document

Reliability data are needed to support many important activities in the life of products and services, i.e., availability evaluation, maintenance decisions, design changes and performance monitoring.

The intent of this document is to provide guidelines for setting up consistent data collection schemes which can be applied either during the investigation of a sample of equipment, or on a more wide spread basis by large maintenance organizations.

This document provides guidance on how to collect these data from various field sources. If the guidelines in this document are followed, accuracy and completeness of reporting are ensured and the quality of the monitored items and their parts can be improved. Moreover, the interchange of information between users and suppliers will be facilitated.

1.4 Limitations/Tailoring Recommendations

The information and guidance presented in this standard is primarily applicable to field systems and equipments. The guidance given is applicable to all levels of design (i.e., component to system) and to most any kind of system. Even though specific examples are not provided, the information is presented in such a way that a data collection system can be tailored, as necessary, for most situations. The only limitation in the standard is the lack of details on data analysis. However, data analysis is not a primary aim of the standard and other IEC standards written for this purpose are referred to accordingly.

CHAPTER 2: IEC 319 - PRESENTATION OF RELIABILITY DATA ON ELECTRONIC COMPONENTS (OR PARTS), SECOND EDITION

This document is dated 1978 and contains 37 pages. Price: $63.00 (67 CHF)

The document replaces IEC Publications 319 and 319A, first edition, in their entirety.

2.1 Outline of Document*

Foreword

Preface

Introduction

Clause

1. Scope
2. Requirements for presenting reliability data

Appendix A Identification of components (Sub-clause 2.1) and test conditions (Sub-clause 2.2)

Appendix B1 Failure rate data

Appendix B2 Additional information required when failure rate cannot be assumed to be constant

Appendix C Change in characteristics: observed results and presentation of derived data

2.2 Document Abstract

This publication provides a template for information to be recorded and presented when individual components are tested to an applicable specification. The data discussed is relevant to reliability information such as test time, number of test samples, failure modes, number of failures, test conditions, etc. Additional requirements are provided for collection and presentation of component characteristic changes (such as gain of a transistor) under various test conditions, or stresses. The purpose of the data presentation is to provide the circuit designer with information needed to properly address reliability at higher levels of design.

2.3 Principal Features of The Document

Templates are provided for the following kinds of information:

- Identification of components and test conditions (Appendix A)
- Failure rate data (Appendix B1)
- Data relating to non-constant failure rates (Appendix B2)

A data form can be found in Appendix A that includes the kind of component, date of manufacture, description of test conditions, characteristic measured, method of measurement, etc. Appendix B1 is a table that lists the following kinds of information: failure criteria, accumulated number of failures, and observed failure rates. Appendix B2 contains two tables, one table requires the kind of failure distribution and distribution parameter estimates, and the second table requires observed values of test time and total number of components under test. Appendix C is concerned with component characteristic data and provides methods of presentation, with examples, and advantages and disadvantages of each.

2.4 Limitations/Tailoring Recommendations

The publication is limited to programs where component testing will be performed to assess reliability and quality characteristics. In the event such testing will occur, then this publication can be used as a guideline for specifying what data is to be collected and how is should be presented.

CHAPTER 3: IEC 409 - GUIDE FOR THE INCLUSION OF RELIABILITY CLAUSES INTO SPECIFICATIONS FOR COMPONENTS (OR PARTS) FOR ELECTRONIC EQUIPMENT, SECOND EDITION

This document is dated 1981 and contains 29 pages. Price: $51.00 (54 CHF)

3.1 Outline of Document*

Foreword

Preface

1. Object
2. Scope
3. Introduction
4. Definitions (in addition to those in IEC Publication 271)
5. Information to be included in specifications
6. Assessed failure rate
7. Reliability testing methods
8. Checklist of factors to be considered when preparing a reliability specification

3.2 Document Abstract

This publication is intended to guide writers of specifications and technical committees in the consideration of factors which would be taken into account in the inclusion of quantitative reliability clauses in specifications for components used in electronic equipment. It mainly applies to the case when a constant failure rate is assumed. Of the various categories of reliability clauses in the specifications for components, the present guide is currently directed at those applying to the finished product and relating to the estimation of failure rates from tests.

3.3 Principal Features of the Document

This guide gives reliability information to be included in specifications for components for electronic equipment, such as basic control concept, series lot control, statement of objectives, test method, criteria of failure, etc. Each part is described and explained. Two different approaches are discussed: reliability compliance testing and reliability determination testing.

This guide provides information on assessed failure rate and reliability testing methods that are to be included in the component specification. It also includes a checklist of factors to be considered when preparing a reliability specification.

3.4 Limitations/Tailoring Recommendations

There are two basic approaches, compliance or determination tests, either of which can be followed. The choice is dependent on the objectives to be met by the specification. Both approaches are applicable to the testing of components which are essentially in continuous production or to the testing of an individual inspection lot.

A single specification may contain both compliance and determination tests. When both types of tests are included, there should be a clear identification as to which test is the compliance test and which test is the determination test.

CHAPTER 4: DSTAN 00-44 (PART 1)/ISSUE 1 - RELIABILITY AND MAINTAINABILITY DATA COLLECTION AND CLASSIFICATION PART 1: MAINTENANCE DATA & DEFECT REPORTING IN THE ROYAL NAVY, THE ARMY AND THE ROYAL AIR FORCE

The original document is dated 26 March 1993 and contains 70 pages.Price: $54.50

4.1 Document Outline

Section One. General
- 0 Introduction
- 1 Scope
- 2 Related documents
- 3 Computer software
- 4 Definition

Section Two. General Characteristic of Service System
- 5 Introduction
- 6 Data collection
- 7 Data processing
- 8 Evaluation of information
- 9 Investigation and remedial action
- 10 Feed back of information

Section Three. Royal Navy Procedures
- 11 Introduction
- 12 Data collection
- 13 Data processing
- 14 Evaluation of information
- 15 Investigation and remedial action
- 16 Procedures for Naval armament stores
- 17 Procedures for Nuclear submarines
- 18 First fitting defects (Naval Weapon Equipment)
- 19 Feedback of information
- 20 Ship availability data
- 21 Equipment availability data
- 22 OASIS engineering applications system
- 23 Equipment related stores usage information

Section Four. Army Defect Reporting and Investigation Procedures for Technical Equipment
- 24 Introduction
- 25 Data collection
- 26 Data processing
- 27 Evaluation

4.2 Document Abstract

This Defense Standard provides general information on the procedures used by the three services for collecting and processing maintenance data, reporting defects and the use of these data and reports to determine subsequent remedial action. This shows how this general information has been tailored for specific types of systems and equipments (e.g., armament stores, submarines, explosives stores, and aero-engines).

4.3 Principal Features of the Document

Section Two of the standard describes the common elements of the systems used by each of the three services.

The purpose of Section Three is to briefly describe the defect reporting and investigation procedures used in the Royal Navy (RN), including data collection and processing. The RN defect reporting procedure has evolved to meet a series of differing requirements, such that there is not a uniform procedure. The differences are in detail rather than in philosophy but there are distinct differences among the systems for surface ships, submarines, aircraft and weapons. This section gives an outline of the philosophy of the RN procedures.

Section Four briefly describes the defect reporting procedures used in the Army for technical equipments, including data collection and processing, and evaluation of defect information. Investigation of defect reports and solution of problems is also briefly covered. All defects in Army equipments are reported and initially screened in similar ways, but different procedures are used for defect investigation and remedial action for explosives stores and for aircraft, missiles and associated equipment.

The purpose of Section Five is to briefly describe the fault reporting procedures used in the Royal Air Force (RAF) and the Fleet Air Arm. The standard notes that the RAF has dropped the use of the term "defect" and replaced it with the term "fault", while the RN and Royal Army continue to use defect. The information in this section includes data collection and the processing and evaluation of fault information. The procedures of this uniform system are modified in detail to take account of special requirements such as aircraft engines, explosives and collaborative projects with other countries. In some cases, for example military

transport, ground weapons and torpedoes, Army or RN fault reporting documentation and procedures are used. All fault data collected by RAF procedures is sent to the Maintenance Analysis and Computing Division (MACD) for processing and storage.

4.4 Limitations/Tailoring Recommendations

Although each primary section of this standard is tailored to specific types of equipments (e.g., explosives stores, aero-engines, Naval armament stores, etc.), the developers of the standard state that the factual information provided will be useful to organizations not directly involved in Service Defect Reporting Systems. Many of the subsections within each section are designed to be tailored to a specific type of system or equipment. However, these were tailored using the general information presented and there appears to be no reason why much of the information contained within cannot be used or applied to other types of systems or equipments as well.

CHAPTER 5: DSTAN 00-44 (PART 2)/ISSUE 1 RELIABILITY AND MAINTAINABILITY DATA COLLECTION AND CLASSIFICATION, PART 2: DATA CLASSIFICATION AND INCIDENT SENTENCING - GENERAL

The original document is dated 29 April, 1994 and contains 10 pages. Price: $34.00

5.1 Document Outline*

Preface

0 Introduction
1 Scope
2 Related Documents
3 Definitions
4 Data Reporting
5 Data Classification
6 Incident Sentencing
7 Incident Sentencing Procedure
8 Incident Sentencing Committee (ISC)

Annex A Glossary of Relevant Terms

5.2 Document Abstract

This Defense Standard provides general guidance on the development of an incident data collection and analysis system. It is most intended for collection of data that occurs during the development of a new system or equipment. However, the information presented is also applicable to a fielded system or equipment as well.

5.3 Principal Features of the Document

The main points of the guidance provided in this document are emphasizing the collection of incident, as opposed to fault or failure, data and information, and then determining the cause, significance (criticality), frequency and chargeability of each incident. Incident sentencing, or classification, should be accomplished by what is termed an Incident Sentencing Committee (ISC), made up of representatives from the prime contractor, design authority, Government project manager, reliability adviser, and user (when applicable). The purpose of the ISC is data categorization based on data analysis, or the recorded data.

Further guidance is provided on the data collection systems themselves. This standard recommends the use of tape recorders, automatic data capture methods, elapsed time indicators (ETIs), etc., where they can be shown to be cost effective. The incident data collection system itself should have established codes that make it simple to describe an incident and therefore facilitates sentencing later on. In each case, the exact nature of the collection system and any reporting codes used are to be agreed upon by the buyer and seller prior to commencement of data collection.

5.4 Limitations/Tailoring Recommendations

Although reference is made to in-service equipments, the guidance provided in this standard is more applicable to systems in development. Because it is a general guidance document, the requirements within should be tailored by mutual agreement between buyer and seller as to the specifics of the data collection system and the make-up and rules associated with data classification codes and sentencing rules.

SECTION 8
PRODUCT/INDUSTRY SPECIFIC DOCUMENTS

PREFACE

The documents summarized in this section were developed for a specific product, such as robotics systems, or for a specific industry, such as the utility industry. While they are important to individuals working with or within the specific areas mentioned, the techniques, guidance and information presented may be applicable to other products or product industries. Specifically, for industries looking for standardized formats of collecting and presenting R, M & A data, the documents on the utility industry will provide some insight into formats that may be applicable. Much like system level R, M & A standards and specifications used in the US military for years, these types of documents provide a common set of standards that everyone can use in evaluating and developing products.

Of the US military standards and specifications affected by DoD Acquisition Reform, MIL-STD-1686, "Electrostatic Discharge Control Program for Protection of Electrical and Electronic Parts, Assemblies and Equipment," best fits the category of Product/Industry Specific Documents. The parts specifications and standards listed in the previous section's preface would also fall under this category, as would MIL-STD-1543, "Reliability Program Requirements for Space and Launch Vehicles." The current status information for MIL-STD-1686 can be found in Section 11, Chapter 7, while the status of MIL-STD-1543 can be found in Chapter 8 of Section 11.

Chapter 1 ANSI/IEEE **500**
Guide to the Collection and Presentation of Electrical, Electronic, Sensing Component, and Mechanical Equipment Reliability Data for Nuclear-Power Generating Stations; November, 1984

Chapter 2 ANSI/IEEE **577**
Standard Requirements for Reliability Analysis in the Design and Operation of Safety Systems for Nuclear Power Generating Stations, 1976, Revision 1992

Chapter 3 ANSI/IEEE **762**
Standard Definitions for Use in Reporting Electric Generating Unit Reliability, Availability, and Productivity; May, 1987

Chapter 4 ANSI/AIAA **R-013-1992**
Recommended Practice for Software Reliability, 1992

Chapter 5 ANSI **R15.05-3**
American National Standard for Industrial Robots and Robot Systems - Reliability Acceptance Testing - Guidelines, October, 1992

Chapter 6 EIA/JEDEC **JEP 70** - Quality and Reliability Standards, July, 1993

Chapter 7 IEC **571 - 3**
Electronic Equipment Used on Rail Vehicles Part 3: Components, Programmable Electronic Equipment and Electronic System Reliability, First Edition, 1990

Chapter 8 IEC **1069 - 5**
Industrial-Process Measurement and Control - Evaluation of System Properties for the Purpose of System Assessment - Part 5: Assessment of System Dependability, First Edition, 1994

Chapter 9 SAE/NCMS **M-110**
Reliability and Maintainability Guideline for Manufacturing Machinery and Equipment, 1993

Chapter 10 ANSI/IEEE **STD352-1987**
IEEE Guide for General Principles of Reliability Analysis of Nuclear Power Generating Station Safety Systems, 1985

CHAPTER 1: ANSI/IEEE 500 - GUIDE TO THE COLLECTION AND PRESENTATION OF ELECTRICAL, ELECTRONIC, SENSING COMPONENT, AND MECHANICAL EQUIPMENT RELIABILITY DATA FOR NUCLEAR-POWER GENERATING STATIONS

This document is dated 1984 and contains 1424 pages. It replaces an earlier, 1977 version.

Price: $250.00

1.1 Outline of Document

1. Introduction
2. Data Processing
3. Data Format
4. References

Appendix A Discussion of the Term *Failure Mode*
Appendix B The Delphi Procedure
Appendix C Development of the Hierarchical Trees and Limitations
Appendix D Reliability Data for Nuclear-Power Generating Stations
- Chapter 1 Annunciator Modules
- Chapter 2 Batteries
- Chapter 3 Circuit Breakers, Interrupters, Relays, Switches and Fuses
- Chapter 4 Motors and Generators
- Chapter 5 Heaters
- Chapter 6 Transformers
- Chapter 7 Valve Operators and Actuators
- Chapter 8 Instruments, Controls and Sensors
- Chapter 9 Conductors
- Chapter 10 Motive Equipment
- Chapter 11 Driven Equipment
- Chapter 12 Transport, Lifting, and Positioning Equipment
- Chapter 13 Energy Absorption Equipment
- Chapter 14 Support Structures
- Chapter 15 Energy Transport, Storage, and Retention Equipment
- Chapter 16 Energy Exchange Equipment
- Chapter 17 Purification Equipment

1.2 Document Abstract

This guide is intended to establish one method of collecting and presenting reliability data for use in nuclear-power generating station reliability calculations as outlined in IEEE STD 352-1975, (IEEE Guide for General Principles of Reliability Analysis of Nuclear-Power Generating Station Protection Systems). The data

contained in Appendix D are intended for use by either nuclear systems reliability analysts or design engineers. The data are normally used by design engineers in models developed by the analysts.

1.3 Principal Features of the Document

IEEE Standard 500 itself is a very brief document, the vast majority of the publication contains detailed component failure rate data. Various failure rate values are provided. Upper and lower data bounds which correlate to worst and best case data are given. The best estimate for a component failure rate is provided by the recommended (REC) failure rate. Component failure modes when available are also provided.

1.4 Limitations/Tailoring Recommendations

Although the data is specific to the nuclear power generating industry, if used judiciously, the data could also be applicable to other industries as well.

CHAPTER 2: ANSI/IEEE 577 - STANDARD REQUIREMENTS FOR RELIABILITY ANALYSIS IN THE DESIGN AND OPERATION OF SAFETY SYSTEMS FOR NUCLEAR POWER GENERATING STATIONS

The original document is dated November 15, 1976 and contains 11 pages.Price: $50.00

2.1 Outline of Document

1. Purpose

2. Scope

3. Definitions

4. Requirements
    4.1 General
    4.2 Qualitative Analysis
    4.3 Quantitative Analysis
    4.4 Evaluation

2.2 Document Abstract

This standard provides acceptable methods of reliability analysis in response to requirements when performing a reliability analysis to demonstrate reliability compliance. The requirement that a reliability analysis be performed does not originate with this standard.

2.3 Principal Features of the Document

This standard provides a good outline of reliability analysis requirements for safety related systems found in Nuclear Power Generating Stations. Section 4 outlines the requirements that are grouped by qualitative analysis, quantitative analysis, and evaluation. The requirements further identify the type of information required and factors that need to be considered in the analysis. The standard does not dictate HOW the analyses should be accomplished, although it does list acceptable methods.

2.4 Limitations/Tailoring Recommendations

Although this standard was developed for nuclear power generating station safety systems, the basic requirements are generic and could be applied to any system. Further, given the fact that the requirements are not task oriented, the user of this document could selectively choose which requirements from each of the three areas, (i.e., quantitative, qualitative, and evaluation), is most applicable to the system being developed.

CHAPTER 3: ANSI/IEEE 762 - STANDARD DEFINITIONS FOR USE IN REPORTING ELECTRIC GENERATING UNIT RELIABILITY, AVAILABILITY, AND PRODUCTIVITY

The original document is dated May 20, 1987 and contains 25 pages. Price: $51.00
History and Revisions: Originally issued for trial use in 1980.

3.1 Outline of Document

1. Purpose

2. Scope

3. Unit States
   - 3.1 Active
     - 3.1.1 Available
     - 3.1.2 Unavailable
     - 3.1.3 Starting Attempt
   - 3.2 Deactivated Shutdown

4. Capacity Terms
   - 4.1 Maximum Capacity (MC)
   - 4.2 Dependable Capacity
   - 4.3 Available Capacity
   - 4.4 Seasonal Derating
   - 4.5 Unit Derating
   - 4.6 Planned Derating
   - 4.7 Unplanned Derating
   - 4.8 Installed Nameplate Capacity

5. Time Designations and Dates
   - 5.1 Available Hours (AH)
   - 5.2 Service Hours (SH)
   - 5.3 Reserve Shutdown Hours (RSH)
   - 5.4 Unavailable Hours (UH)
   - 5.5 Planned Outage Hours (POH)
   - 5.6 Unplanned Outage Hours (UOH)
   - 5.7 Forced Outage Hours (FOH)
   - 5.8 Maintenance Outage Hours (MOH)
   - 5.9 Deactivated Shutdown Hours (DSH)
   - 5.10 Period Hours (PH)
   - 5.11 Unit Derated Hours (UNDH)
   - 5.12 Planned Derated Hours (PDH)
   - 5.13 Unplanned Derated Hours (UDH)
   - 5.14 Forced Derated Hours (FDH)
   - 5.15 Maintenance Derated Hours (MDH)

5.16 Seasonal Derated Hours (SDH)
5.17 Equivalent Hours (EH)
5.18 Deactivation Date
5.19 Reactivation Date

6. Energy Terms
   6.1 Actual Generation (AAG)
   6.2 Maximum Generation (MG)
   6.3 Available Generation (AG)
   6.4 Unavailable Generation (UG)
   6.5 Seasonal Unavailable Generation (SUG)
   6.6 Reserve Generation (RG)
   6.7 Derated Generation (DG)

7. Performance Indexes
   7.1 Planned Outage Factor (POF)
   7.2 Unplanned Outage Factor (UOF)
   7.3 Forced Outage Factor (FOF)
   7.4 Maintenance Outage Factor (MOF)
   7.5 Unavailability Factor (UF)
   7.6 Availability Factor (AF)
   7.7 Service Factor (SF)
   7.8 Seasonal Derating Factor (SDF)
   7.9 Unit Derating Factor (UDF)
   7.10 Equivalent Unavailability Factor (EUF)
   7.11 Equivalent Availability Factor (EAF)
   7.12 Gross Capacity Factor (GCF)
   7.13 Net Capacity Factor (NCF)
   7.14 Gross Output Factor (GOF)
   7.15 Net Output Factor (NOF)
   7.16 Forced Outage Rate (FOR)
   7.17 Equivalent Forced Outage Rate (EFOR)
   7.18 Mean Service Time to Outage
   7.19 Mean Outage Duration
   7.20 Starting Reliability (SR)
   7.21 Cycling Rate (CR)

3.2 Document Abstract

This document standardizes terminology and indexes for reporting electric generating unit reliability, availability, and productivity performance measures. It provides a common source of definitions that allows exchange of meaningful data among systems in North America and throughout the world.

3.3 Principal Features of the Document

This standard provides a comprehensive set of definitions used in reporting reliability, availability and productivity data for the electric power industry. Mathematical definitions as well as word definitions are provided, where applicable. The purpose of the standard is to allow exchange of meaningful data within the industry. Several notes are also provided to help in clarification of how to determine the kinds of data to be reported and aid in the mathematical calculation of such factors. The standard could serve as an excellent training aid to reliability engineers new to the power industry or who are trying to learn more about reliability terms used in the power industry.

3.4 Limitations/Tailoring Recommendations

This standard is exclusively applicable to the electric power industry. Tailoring of the document is not relevant.

CHAPTER 4: ANSI/AIAA R-013-1992 - RECOMMENDED PRACTICE - SOFTWARE RELIABILITY

This document is dated 1992, and contains 70 pages. Price: $50.00

4.1 Outline of Document

Rome Laboratory was unable to obtain permission from the AIAA to reprint the Table of Contents for this document prior to completion of this report. However, the document covers the following areas of software reliability:

- Modeling - Overview, Concepts and Advantages
- Estimation Procedures
- Estimation Models
- Data

The document also contains a bibliography and several appendices that provide additional material on software reliability, models, automated measurement tools, and using reliability models for developing test strategies.

4.2 Document Abstract

This document outlines an approach to developing the means to predict and estimate the reliability of software for a given project. This includes methods for defining failures, choosing a reliability prediction model, establishing data collection and analysis procedures, and integration of software reliability estimates with overall system reliability estimates where hardware is being developed.

4.3 Principal Features of the Document

This document is an excellent resource document on software reliability. Not only is guidance provided on how to develop estimates of software reliability, but information on several reliability estimating models is provided, as well as information on each model's objectives and accepted uses. Additional guidance is given on the establishment of a data collection system to support software reliability estimation and improvement. Finally, the appendixes provide valuable information on other software reliability models, automated tools that include

company names, points of contact, price and hardware/software environment, and tailoring guidance for the document using an example project scenario.

4.4 Limitations/Tailoring Recommendations

While the document was specifically developed for software, some parts are useable for any type of program where data collection is necessary to support the end product. Specifically, much of Section 7, Software Reliability Data, could be used as guidance for establishing any kind of data collection and analysis system. Because of the way the document is structured, any part of the document could be used stand-alone. For instance, if a data collection process is already in place, only the section on estimation models could be used. Likewise, if estimation models have been established, but the program lacks a data collection process, Section 7 could be used.

CHAPTER 5: ANSI RIA R15.05-3 - AMERICAN NATIONAL STANDARD FOR INDUSTRIAL ROBOTS AND ROBOT SYSTEMS - RELIABILITY ACCEPTANCE TESTING - GUIDELINES

This document is issued by: American National Standards Institute and the Robotic Industries Association. It is dated October 12, 1992 and contains 11 pages.

Price: $20.00

5.1 Outline of Document

Foreword

1. Scope, purpose and exclusions
2. Normative references
3. Definitions
4. Infant Mortality Life Test (IMLT)
5. Functional Verification (FV)
6. Twenty-four (24) hour Individual Axis Movement Test (IAMT)
7. Forty-eight (48) hour Composite Axes Movement Test (CAMT)
8. Optional Infant Mortality Life Test (OIMLT) Methods 1 and 2
9. IMLT log

5.2 Document Abstract

The purpose of this document is to provide assurance, through testing, that infant mortality failures in industrial robots have been detected and corrected by the manufacturer (or rebuilder) at their facility, prior to shipment to a user.

5.3 Principal Features of the Document

This guideline provides test times and criteria for acceptance (48 hour failure free (critical failure only) test time of Composite Axes Movement Test (CAMT) followed by a failure free (critical failure) Functional Verification (FV) test).

5.4 Limitations/Tailoring Recommendations

This guide is strictly applicable to industrial robots or robot systems, both newly developed and rebuilt. It is not a reliability acceptance test, rather it is a test to provide assurance that infant mortality failures have been found and corrected prior to release to the field.

CHAPTER 6: EIA/JEDEC JEP 70 - QUALITY AND RELIABILITY STANDARDS

This document is dated July, 1993 and contains 25 pages. Price: $37.00

6.1 Outline of Document

1. Scope
2. Introduction
3. Listing of Quality and Reliability Standards
   - 3.1 Electrical Tests - Methods
   - 3.2 ESD Control - Measurement, Handling, Symbol & Label
   - 3.3 Mark-Pack-Ship - Container Labeling/Bar coding, Tape & Reel, Dry-Packing
   - 3.4 Process Control - SPC, C, Control Charting, Environmental Controls, Calibration
   - 3.5 Qualification and Reliability Monitor - Initial Product/Process Qualification, Ongoing Reliability Monitoring, Qualification of Product/Process Changes
   - 3.6 Quality and Reliability Reporting - AOQ Measurement, Sampling Methods, Reliability Data (FITS), Failure Analysis, Product/Process Change Notification
   - 3.7 Quality Systems - General Requirements, Auditing, Terminology, Certification, Supplier/Subcontractor Control
   - 3.8 Reliability Testing - Methods
   - 3.9 Visual and Mechanical Testing - Methods
4. Addresses of Standards Sources

Index

6.2 Document Abstract

This document contains a listing and description of commonly used quality and reliability related publications applicable to the semiconductor industry. It is intended to be a reference aid in finding available standards and obtaining a copy from the source of the standard. It is not intended to recommend or imply the applicability of any standard for a specific purpose.

6.3 Principal Features of the Document

The more than 140 quality and reliability standards listed in this publication have been categorized into nine subsections. The last section is an alphabetized listing of the sources for the standards with their addresses and phone numbers. Most of the standards mentioned in the document are not individually addressed in this primer because they are part-oriented rather than system-oriented.

6.4 Limitations/Tailoring Recommendations

This document provides guidance specifically to those industries concerned with the manufacturing and procuring of semiconductor devices.

CHAPTER 7: IEC 571 - 3 - ELECTRONIC EQUIPMENT USED ON RAIL VEHICLES PART 3: COMPONENTS, PROGRAMMABLE ELECTRONIC EQUIPMENT AND ELECTRONIC SYSTEM RELIABILITY

This document is dated 1990 and contains 35 pages. Price: $63.00

7.1 Outline of Document*

Foreword

1.0 General
- 1.1 Scope
- 1.2 Normative references

2.0 Components
- 2.1 Specifications
- 2.2 Choice and selection of components
- 2.3 Ordering of components
- 2.4 Checking of components
- 2.5 Conditions of use for the components

3.0 Programmable Electronic Equipment
- 3.1 Constituent parts and hardware
- 3.2 Rules relating to hardware
- 3.3 Rules relating to software
- 3.4 Interface to man-machine communication

4.0 Electronic System Reliability
- 4.1 Reliability level
- 4.2 Proof of reliability

7.2 Document Abstract

This document, Part 3 of IEC 571, presents the rules applicable to electronic equipment defined in the scope of IEC 571-1, "Rules for Electronic Equipment Used on Rail Vehicles - Part 1: General Requirements and Tests for Electronic Equipment" relative to: a) choice of components, b) use of Programmable Electronic Systems and c) reliability of Electronic Systems. Safety circuits, if required, shall meet additional requirements.

7.3 Principal Features of the Document

This document provides part selection and control guidance for components and programmable electronic equipment used within rail systems. Component related program elements discussed in this standard include vendor selection, screening and components with prohibited and/or limited usage.

Programmable electronic equipment, as defined in the standard, includes equipment for signal processing (hardware), programs and/or sets of data for determining the tasks to be performed by the equipment (software). Hardware requirements highlighted include elements pertaining to component selection (in particular, the use of large scale integration (LSI) components from qualified manufacturers), component mounting, electromagnetic compatibility, self test and restart systems, and battery maintained memory. Rules for software include requirements definition, using a structured design approach, documenting the design, and software testing.

A section discussing electronic system reliability is provided. The following aspects are discussed: equipment specification; system design; circuit design, mechanical design, layout and software; component reliability; life expectancy; operational stress levels due to temperature, rating, vibration, duty cycle, etc.; manufacturing quality; and maintenance.

7.4 Limitations/Tailoring Recommendations

All requirements in this standard apply to newly designed products but not to those resulting from the continuation of production series or using solution based upon concepts already introduced.

CHAPTER 8: IEC 1069-5 - INDUSTRIAL-PROCESS MEASUREMENT AND CONTROL - EVALUATION OF SYSTEM PROPERTIES FOR THE PURPOSE OF SYSTEM ASSESSMENT - PART 5: ASSESSMENT OF SYSTEM DEPENDABILITY

This document is dated 1994 and contains 66 pages. Price: $119.00

8.1 Outline of Document*

Foreword

Introduction

1. Scope
2. Normative references
3. Definitions
4. Dependability properties
   - 4.1 General
   - 4.2 Dependability
   - 4.3 Availability
   - 4.4 Reliability
   - 4.5 Maintainability
   - 4.6 Credibility
   - 4.7 Security
   - 4.8 Integrity
5. Review of the system requirements document
6. Review of the system specification document
7. Assessment procedure
   - 7.1 General
   - 7.2 Analysis of the system requirements document and system specification document
   - 7.3 Designing the assessment programme
   - 7.4 Assessment programme
8. Evaluation techniques
   - 8.1 General
   - 8.2 Qualitative evaluation techniques
   - 8.3 Quantitative evaluation techniques
9. Execution and reporting of the assessment

ANNEXES

A. Example of required information and documentation format for a master-slave control task in a systems requirements document
B. Example of required information and documentation format for a master-slave control task in a system specification document
C. Credibility tests
D. Bibliography

8.2 Document Abstract

This standard deals with a method that can be used to assess the dependability of industrial-process measurement and control systems. Details are provided on assessing dependability by assessing the subsidiary properties of dependability which are defined as Availability (Reliability and Maintainability) and Credibility (Integrity and Security). Definitions, assessment and evaluation techniques (qualitative and quantitative) and examples are provided.

8.3 Principal Features of the Document

This standard describes in detail the method to be used to systematically assess the dependability of industrial-process measurement and control systems. The scope and properties associated with a dependability analysis are provided. The inclusion of the proper dependability properties and information into system requirements and system specification documents is discussed. A general overview of dependability assessment procedures and evaluation techniques is also provided. References to sources, typically IEC documents, are given to provide the details required to fully implement a dependability analysis.

8.4 Limitations/Tailoring Recommendations

A dependability assessment can only be carried out if a mission has been stated (or given) or if any mission can be hypothesized. In the absence of a mission, no assessment can be made. However, evaluations can still be specified and carried out for use in assessments performed by others. In such cases, the standard can be used as a guide for planning an evaluation.

While describing the evaluation of system dependability for industrial-process measurement and control systems, the document does not include detailed descriptions on implementation. The standard does however provide references to other IEC documents to assist the user in the implementation and performance of a dependability analysis.

CHAPTER 9: SAE/NCMS M-110 - RELIABILITY AND MAINTAINABILITY GUIDELINE FOR MANUFACTURING MACHINERY AND EQUIPMENT

This document is dated 1993, and contains 102 pages. Price: $12.00

9.1 Outline of Document

Mission

Section 1. Introduction and Benefits
- Introduction
- Benefits of R & M
  - Safety
  - Reduced Life Cycle Cost
  - Examples of Life Cycle Cost Improvement

Section 2. Implementing R & M Through the Life Cycle Process
- Introduction
- Five-Phase Program Management Process
  - Phase 1 - Concept
  - Phase 2 - Development/Design
  - Phase 3 - Build & Install
  - Phase 4 - Operation and Maintenance
  - Phase 5 - Decommissioning and/or Conversion
  - Summary of Phases
- R & M Application Guide
- Tailoring R & M Activities over the Life Cycle Phases

Section 3. User and Supplier R & M Activities in the Concept Phase
- Introduction
- User Responsibilities
  - Reliability Requirements
  - Maintainability Requirements
  - Machinery Use
  - Duty Cycle
  - Machinery Environment
  - Continuous Improvement Monitoring
  - Life In Terms of Throughput
  - Machine Performance Data Feedback Plan
- Supplier Responsibilities
- R & M Activities Checklist

Section 4. User and Supplier R & M Activities in the Design and Development Phase

- Introduction
- User Responsibilities
- Supplier Responsibilities
  - Design Margins
  - Maintainability Design Concepts
  - Reliability Analysis and Predictions
  - Accelerated Life Test
  - Failure Modes and Effects Analysis/Fault Tree Analysis
  - Design Reviews
- R & M Activities Checklist

Section 5. User and Supplier R & M Activities in the Build and Install Phase

- Introduction
- User Responsibilities
- Supplier Responsibilities
  - Machinery Parts
  - Tolerance Studies
  - Stress Analysis
  - Dedicated Reliability Testing (Qualification Testing)
  - Reliability Data Collection During Acceptance Testing
  - Reliability Data Collection at the User's Plant
  - Root Cause/Failure Analysis
- R & M Activities Checklist

Section 6. User and Supplier R & M Activities in the Operation and Support Phase

- Introduction
- User Responsibilities
- Supplier Responsibilities
  - Reliability Growth/Maintainability Improvement
  - Failure Reporting, Analysis and Corrective Action System
  - Data Exchange
- Suggested Universal Data Feedback Model
- R & M Activities Checklist

Section 7. R & M and Contracting

- Introduction
- Planning
- R & M Matrix
- R & M Program Planning Worksheet
- Procurement

Appendix A R & M Tools and Techniques
Appendix B R & M Training
Appendix C R & M and Life Cycle Costs

9.2 Document Abstract

This guideline is intended to provide a description of reliability and maintainability (R&M) fundamentals for manufacturing machinery and equipment user and supplier personnel at all operating levels. It embraces a concept of up-front engineering and continuous improvement in the design process for machinery and equipment. The document is not intended to be a primer on R&M. It simply represents standard techniques as they apply to the life cycle of machinery and equipment, and gives a sequence of R&M actions to be followed.

9.3 Principal Features of the Document

This document provides R&M techniques, and guidance on where to apply them, both in the up-front design and development of new equipment and in continuous improvement of the machinery after installation. Predictable R&M of the machinery and equipment is a key ingredient in maintaining production efficiency and the effective deployment of "Just-in-Time" principles. Successful implementation of R&M guidelines requires a cooperative effort between user and supplier. Neither participant in the process can accomplish the objectives alone.

Application-specific R&M techniques are prescribed for each unique equipment acquisition by employing standardized worksheets that are keyed to an appropriate R&M matrix. The process is supported by appendices that enhance the understanding of the underlying technical aspects of R&M.

9.4 Limitations/Tailoring Recommendations

The majority of the work on this document was done by personnel from transportation-related industries, and the guideline reflects this orientation.

CHAPTER 10: ANSI/IEEE STD 352-1987 IEEE GUIDE FOR GENERAL PRINCIPLES OF RELIABILITY ANALYSIS OF NUCLEAR POWER GENERATING STATION SAFETY SYSTEMS

This document is dated November, 1985 and contains 147 pages. It replaces an earlier, 1975 version. Price: $78.00

10.1 Outline of Document

1. Introduction and References
   - 1.1 Introduction
   - 1.2 References
2. Definitions
3. Objectives and Methods
   - 3.1 Consideration of the Human Factor
   - 3.2 Qualitative Analysis
   - 3.2 Quantitative Analysis
   - 3.4 Applications of Reliability Methodology
     - 3.4.1 Failure Modes and Effects Analysis (FMEA)
     - 3.4.2 Logic Trees
     - 3.4.3 System Modeling
     - 3.4.4 Reliability Testing
4. Quantitative Analysis Principles
   - 4.1 Failure Modes and Effects Analysis (FMEA)
     - 4.1.1 Purposes of Failure Modes and Effects Analysis
     - 4.1.2 Timing of Failure Modes and Effects Analysis
     - 4.1.3 Preparatory Steps for a Failure Modes and Effects Analysis
     - 4.1.4 Procedure for a Failure Modes and Effects Analysis
   - 4.2 Fault Tree Analysis
     - 4.2.1 Functions and Benefits of Fault Tree Analysis
     - 4.2.2 Representation of Events and Operations in a Fault Tree
     - 4.2.3 Procedure for Constructing a Fault Tree
   - 4.3 Reliability Block Diagram
   - 4.4 Example
     - 4.4.1 Description of a Typical Reactor Trip Function
     - 4.4.2 Failure Mode and Effects Analysis
     - 4.4.3 Fault Tree Analysis
     - 4.4.4 Reliability Block Diagram
   - 4.5 Extended Qualitative Analysis for Common-Cause Failures
     - 4.5.1 Extension of the FMEA
     - 4.5.2 Extended Fault Tree Analysis
     - 4.5.3 Termination of the Analysis
5. Quantitative Analysis Principles
   - 5.1 Mission Definition
     - 5.1.1 Reliability
     - 5.1.2 Availability (Steady-State)
   - 5.2 Mathematical Modeling

10.2 Document Abstract

This document is basically a general reliability tutorial. It was prepared specifically to provide the designers and operators of nuclear power plant safety systems and the concerned regulatory groups with the basic principles and the essential methods and procedures that are needed to conduct a reliability analysis of such systems. By applying the principles given, systems may be analyzed, the results may be compared with the stated reliability objectives and the basis for engineering trade-offs and decisions may be suitably documented.

10.3 Principle Features Of The Document

This guide is unique in clearly differentiating between the qualitative and quantitative aspects of reliability and the individual advantages of each approach. It clearly presents the general principles that may be used to evaluate both qualitative and quantitative reliability and availability of safety-related nuclear power plants. Numerous worked out examples of each of the various methodologies also enhance this guide.

Qualitative analyses (e.g., FMEA, Fault Trees, Block Diagrams, etc.) provide the designer with the identification of the various failure modes and the parts of a system that contribute to system unreliability. They also indicate ways to increase the probability that the system will perform its intended function for the environments and for the time periods of interest.

Quantitative principles are applicable to the analysis of the effects of component failures on safety system reliability. These analyses utilize existing data sources plus the actual operating experience of the system's components and provide the designer with a numerical estimate of the system's reliability. The output of these analyses may then be used to determine the adequacy of the system and help to establish the operating procedures, such as testing, and the applicable operating intervals between these necessary tests.

In contrast to most other reliability methodology publications, consideration of the Human Factor is specifically addressed in this guide, although it is acknowledged that the data available in this area is more limited than it is for component data. The guide clearly recognizes the general need for reliability data

and includes a listing of a number of established data programs (many of which are not normally identified elsewhere) that may be used as possible data sources.

10.4 Limitations/Tailoring Recommendations

The principles in this guide are applicable during any phase of the system's lifetime. They have their greatest value, of course, during the design phase, however, the principles may also be applied during the preoperational phase, or at any time during the normal lifetime of a system.

Although written specifically for the nuclear power generating industry, the principles herein contained are generally very generic and given the guide's clear tutorial approach, they have a broad application to many other industries and fields.

SECTION 9
MANAGEMENT

PREFACE

Without proper planning and management of an R, M & A program, even the best intentions are doomed to fail. Management starts with the development of R, M & A program plans, and continues with constant review and assessment throughout the product development process. Management of product improvement can be through the planning and implementation of methodologies such as a reliability growth program.

The documents summarized in this section provide guidance and information on aspects of management. Included are documents on dependability program management, planning and participation in formal design reviews, and planning and management of reliability growth programs. Like most documents on management, these documents have been written for program managers responsible for the planning and oversight of the R, M & A functions within a product development team.

The US military R, M & A standards and specifications that fall under the category of management, but have not been reviewed as part of this effort are listed below. The current status of these documents under DoD Acquisition Reform can be found in Section 11, Chapter 8. Other documents that may have been categorized under another heading, but also relate to management, are also listed below.

- MIL-STD-785 Reliability Program for Systems and Equipment Development and Production
- MIL-STD-1543 Reliability Program Requirements for Space and Launch Vehicles
- MIL-Q-9858 Quality Program Requirements
- MIL-STD-470 Maintainability Program for Systems and Equipment (see Chapter 5 of Section 11)
- MIL-STD-2165 Testability Program for Electronic Systems and Equipments (see Chapter 5 of Section 11)

- MIL-STD-790 Reliability Assurance Program for Electronic Parts Specifications (see Chapter 6 of Section 11)

- MIL-STD-882 System Safety Program Requirements (see Chapter 9 of Section 11)

Chapter 1 ISO **9000-4**

Quality Management and Quality Assurance Standards - Part 4: Guide To Dependability Programme Management/IEC **300 - 1** Dependability Management - Part 1: Dependability Programme Management, First Edition; 1993 (Replaces IEC 300)

Chapter 2 IEC **1014**

Programmes for Reliability Growth, First Edition, 1989

Chapter 3 IEC **1160**

Formal Design Review, First Edition, 1992

Chapter 4 ANSI/SAE **AIR 4276**

Survey Results: Computerization of Reliability, Maintainability & Supportability (RM&S) in Design, January, 1990

Chapter 5 CAN/CSA-**Q632-90**

Reliability and Maintainability Management Guidelines, May 1990

Chapter 6 Interim DSTAN **00-60** (Part 0) - Integrated Logistic Support: Part 0: Application of Integrated Logistics Support (ILS)

Chapter 7 INT DSTAN **00-60** (Part 2) - Integrated Logistics Support, Part 2: Guide to the Application of LSA and LSAR

Chapter 8 BS **5760**: Part 1: 1985 Reliability of Constructed or Manufactured Products, Systems, Equipments and Components, Part 1. Guide to Reliability and Maintainability Programme Management

Chapter 9 **ARMP-1**, Edition 2: NATO Requirements for Reliability and Maintainability

Chapter 10 NASA NHB **5300.4** (1A-1) - Reliability Program Requirements for Aeronautical and Space System Contractors

CHAPTER 1: ISO 9000-4 QUALITY MANAGEMENT AND QUALITY ASSURANCE STANDARDS - PART 4: GUIDE TO DEPENDABILITY PROGRAMME MANAGEMENT/IEC 300 - 1 - DEPENDABILITY MANAGEMENT, PART 1: DEPENDABILITY PROGRAMME MANAGEMENT (REPLACES IEC 300)

This document is dated 1993 and contains 21 pages. Price: $52.00

1.1 Outline of Document*

1.2 Document Abstract

This part of IEC 300/ISO 9000 provides guidance on dependability program management. It covers the essential features of a comprehensive dependability program for the planning, organization, direction and control of resources to produce products which will be reliable and maintainable. In management terms, it is concerned with what has to be done, and why, and when and how it has to be done, but it is not specific about who should do it and where, because organizations and projects vary widely.

1.3 Principal Features of the Document

This part of IEC 300/ISO 9000 is applicable to hardware and/or software products, where dependability characteristics are significant during the operation and maintenance phase. The requirements are aimed primarily at controlling influences on dependability at all life-cycle phases from product planning to operation.

IEC 300-1 cancels and replaces IEC 300 dated 1984.

1.4 Limitations/Tailoring Recommendations

Any agreement using the guidance given in this part of IEC 300/ISO 9000 may use selected parts to fit particular circumstances. The parties involved should agree upon and record the extent to which it is applied, including the guidance given in other parts of the IEC 300 series. Any selected clauses used in this way may then become requirements.

CHAPTER 2: IEC 1014 - PROGRAMMES FOR RELIABILITY GROWTH*

*Identical to BSI Document BS 5760: Part 6: 1991 - Reliability of Systems, Equipments and Components: Guide to Programme for Reliability Growth.

This document is dated October, 1989 and contains 31 pages. Price: $98.00

2.1 Outline of Document♦

5. Management aspects
    5.1 Procedures
    5.2 Liaison
    5.3 Manpower and costs
    5.4 Cost benefits

6. Planning of reliability growth programmes
    6.1 Number of items to be tested
    6.2 Testing by stressing
    6.3 Programme duration
    6.4 Planned growth and growth monitoring
    6.5 Special consideration for non-repaired or one-shot items and component parts

7. Classification of failures
    7.1 Classes of non-relevant failures
    7.1 Classes of relevant failures
    7.3 Categories of relevant failures

8. Process of reliability improvement

9. Mathematical modeling
    9.1 Nature and objectives of modeling
    9.2 Concept of reliability measures as used in modeling

10. Reporting and documentation

2.2 <u>Document Abstract</u>

This standard specifies requirements and gives guidance for the exposure and removal of weaknesses in hardware and software items for the purpose of reliability growth. Reliability improvement by a growth program should be part of an overall reliability activity in the development of a product. This is especially true for a design which uses novel or unproved techniques or component parts or a substantial content of software. In such a case the program may expose, over a period of time, many types of weaknesses having design related causes. It is essential to reduce the probability of failure due to these weaknesses to the greatest extent possible to prevent their later appearance in formal tests or in the field. At that late stage, design correction is often highly inconvenient, costly and time-consuming.

2.3 Principal Features of the Document

This document stresses the planning and management of a reliability growth program, rather than the mathematical modeling and estimation techniques found in other documents on the same subject. It is emphasized that it is more important to identify weaknesses in the design and institute corrections than to fit the growth test data to a specific model. In fact, the document states that "Since estimation of growth is of less importance than the process of improvement, modeling shall be omitted if the model requirements are not fulfilled, rather than risk giving misleading results." In the area of planning and management, the document outlines those functions within the system design team that may need to be included in any follow-up action to corrective actions defined as a result of failures that may occur during growth testing. Attention is also paid to making sure that the test environment is accurate and consistent from test phase to test phase. The mathematics of estimating reliability, in terms of failure intensity, is briefly outlined, but no details or examples are provided. The use of graphs and figures are made to explain the principles behind growth estimation.

2.4 Limitations/Tailoring Recommendations

This standard focuses primarily upon reliability improvement through testing but the same general principles may also apply to other activities, even if not required by a formal program. Improvement may be based on theoretical studies (i.e., failure modes and effects analysis), field trials, users' experience, and tasks not aimed primarily at reliability improvement. Clause 9 of the document, which covers mathematical modeling, limits the discussion to situations where reliability is measured by failure intensity or by MTBF. However, it does provide a discussion for one-shot devices and non-repairable systems, where reliability is typically measured by MTTF. The document is best used to help plan and manage a growth test program. Other documents should be referred to for the mathematical modeling and estimation of growth based on test results.

CHAPTER 3: IEC 1160 - FORMAL DESIGN REVIEW*

*Identical to BSI Document BS 5760: Part 14: 1993 - Reliability of Systems, Equipment and Components: Guide to Formal Design Review.

This document is dated 1992 and contains 63 pages. Price: $119.00

3.1 Outline of Document•

Foreword

Introduction

1. Scope

2. Normative references

3. Definitions

4. Application of formal design review

5. Management of the process
   - 5.1 Policy statement
   - 5.2 Precautions

6. Design reviews during life cycle phases
   - 6.1 Types
   - 6.2 General objectives
   - 6.3 Specific objectives

7. Team composition and qualities
   - 7.1 Common qualities
   - 7.2 Specific considerations
   - 7.3 Chairperson
   - 7.4 Secretary
   - 7.5 Specialists
   - 7.6 Designers and developers

8. Planning and scheduling
   8.1 Introduction
   8.2 Timing
   8.3 Schedule

9. Implementation
   9.1 General
   9.2 Notification and agenda
   9.3 Input data
   9.4 Topics
   9.5 Conduct of formal design review meetings
   9.6 Documentation
   9.7 Follow-up
   9.8 Legal approval

10. Role of specialist
    10.1 All specialists
    10.2 Individual specialist

3.2 Document Abstract

This standard makes recommendations for the implementation of design review procedures as a means of stimulating product development and for process improvement. It includes guidelines for planning and conducting design reviews and specific details concerning contributions by reliability, maintenance, maintenance support and availability specialists. This standard also includes guidance for specialty areas dealing with quality, environment, safety (product and user), human factors, and legal matters.

3.3 Principal Features of the Document

The standard provides an outline and description of design reviews by product phase, including topics to be discussed and responsibilities. Design reviews for the following phases are presented: Concept and Definition, Design and Development, Manufacturing and Installation, and Operations and Maintenance. Other sections of the standard are devoted to the individuals who should attend, organize and lead each design review, other than the project design team. Detail is provided on how each design review team should be trained and conduct themselves, as well as individual responsibilities. Another major section is devoted to outlining specialty areas as they relate to formal design reviews. Specifically, the standard outlines

areas to be focused upon during each design review for the following specialty disciplines: reliability, maintenance, maintainability, maintenance support performance, availability, quality, environmental effects, product safety, human factors and legal matters. Note that text describing environmental effects, human factors and legal matters is currently in the process of being developed and is therefore not yet available. Finally, two tables are provided. One table showing product life cycle phases and applicable design review types, and the other showing design review team member responsibilities and design reviews each member should attend.

3.4 Limitations/Tailoring Recommendations

The only minor limitation of this standard is the lack of information presented on review of a product's diagnostic design. The information is presented in a format easily tailored to the level of detail relevant to any product development program. However, no specific guidance is given as to how to tailor the information.

CHAPTER 4: ANSI/SAE AIR 4276 - SURVEY RESULTS: COMPUTERIZATION OF RELIABILITY, MAINTAINABILITY AND SUPPORTABILITY (RM&S) IN DESIGN

This document is dated January 1, 1990 and contains 29 pages. Price: $35.00

4.1 Outline of Document

1. Scope
2. Purpose
3. Background
4. Discussion
   - 4.1 Management
   - 4.2 Technical
   - 4.3 General
5. Conclusion
6. Recommendation

Appendix A Survey

4.2 Document Abstract

This Aerospace Information Report (AIR) is used as a vehicle for providing survey results that pertain to information gathered on the extent of computerization of RM&S into the design process to industry and government. The Institute for Defense Analysis (IDA) performed a study which concluded that computerized techniques must be developed to integrate RM&S into product design in order to permit design influence from inception throughout the product life cycle. This AIR addresses the DoD initiative for developing Computer Aided Acquisition and Logistic Support (CALS) and industry's role in its evolution.

4.3 Principal Features of the Document

AIR 4276 provides the detailed results of an industry/government survey inquiring into the extent of computerization of RM&S into the design process.

Background information describes the evolution of the survey and why it was developed. The results provide demographic information about the respondents, the existence and extent of their CALS policy and plans, the priority placed on each RM&S task, and the extent to which these tasks have been computerized into the design process. Recommendations based on the survey are included. A copy of the survey is included as Appendix A of the document.

4.4 Limitations/Tailoring Recommendations

The overall purpose of this report is to heighten industry/government awareness as to the importance of computerizing RM&S into design. Therefore there are no particular limitations or recommendations on this document.

CHAPTER 5: CAN/CSA-Q632-90 - RELIABILITY AND MAINTAINABILITY MANAGEMENT GUIDELINES

This document is dated May, 1990 and contains 18 pages. Price: $58.50

5.1 Outline of Document[1]

Preface

1. Scope

2. Reference Publication

3. Definitions

4. General Requirements
    - 4.1 General
    - 4.2 The Life Cycle Concept
    - 4.3 Reliability and Maintainability Programme
    - 4.4 Reliability and Maintainability Activities Guidelines
    - 4.5 Establishment of Reliability and Maintainability Plan and Objectives
    - 4.6 Definition and Analysis of Operating Conditions
    - 4.7 Evaluation of Product Reliability and Maintainability Concepts
    - 4.8 Establishment of Maintenance Policy and Analysis of Requirements
    - 4.9 Establishment of Product Design Guidelines
    - 4.10 Evaluation of Contractual Reliability and Maintainability Requirements and Interfaces
    - 4.11 Selection of Reliability and Maintainability Analyses
    - 4.12 Evaluation of Risk and Cost
    - 4.13 Design Reviews
    - 4.14 Verification and Compliance
    - 4.15 Documentation and Data
    - 4.16 Corrective Action and Product Improvement
    - 4.17 Training and Support Programmes

5.2 Document Abstract

The subject of this standard is the presentation of useful guidelines for reliability and maintainability management and the associated tasks. The standard is aimed at companies of all sizes wanting to implement reliability and

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maintainability management tasks. It outlines guidelines appropriate to each of the defined phases of the life of industrial and commercial products in all technologies. It is intended to serve as a general standard on technical aspects of reliability and maintainability.

5.3 Principal Features of the Document

This standard does an excellent job of defining the different life cycle phases of any product and relates the important factors of a design to how they will affect reliability and maintainability decisions. Clear outlines are provided for reliability and maintainability tasking, in relation to a specific product life cycle phase. The document provides guidance not only on which tasks should be performed during each of the five defined product phases, but provides guidance on which factors must be considered when making decisions. These factors include cost, operating conditions, maintenance policy, risk analysis, and training and support requirements. Sections are provided that relate to commercial products, such as determining whether it is cost effective for a manufacturer to introduce a new and more reliable product to the market, recognizing an ever increasingly competitive market. The document also covers contractual reliability and maintainability requirements, but not to any great level of detail. For each general task area, (i.e., program plans, design reviews, verification, analysis tasks), the document provides guidance on other factors of the design and development process, as well as usage factors, that should be considered when making decisions.

5.4 Limitations/Tailoring Recommendations

Although the document does an excellent job in outlining what factors to consider when determining how much reliability and maintainability development is needed, less information is provided on maintainability tasking. A separate section is devoted to Establishment of Maintenance Policy, however, more detail on reliability tasking and analysis techniques are provided than for similar maintainability tasking and analysis. Despite this one limitation, the document is set up to be tailored in that all life cycle phases are clearly defined, and factors that need to be considered before making reliability and maintainability decisions are well defined. This format clearly puts the emphasis on tailoring reliability and maintainability based on product and customer needs.

CHAPTER 6: INTERIM DSTAN 00-60 (Part 0) - INTEGRATED LOGISTIC SUPPORT: PART 0: APPLICATION OF INTEGRATED LOGISTIC SUPPORT (ILS)

This document is dated 3 October, 1994, and contains 575 pages. Price: $222.50

6.1 Document Outline*

6.2 Document Abstract

This standard is an interim standard designed to initiate the harmonization of several well known logistic support analysis (LSA) documents for international, non-military, and military use. The standard is the first of three planned phases where Phase 1 profiles MIL-STD-1388/1A and 2B together with Association Européene des Constructeurs de Materiel Aérospatial (AECMA) S2000M Initial Provisioning (IP) functions. Phase 2 will deliver the Order Administration, Procurement Planning, Invoicing, Spares Consumption Data Exchange elements of S2000M, and LSA for software. Phase 3 will deliver Technical Documentation elements of AECMA S1000D, along with the ability to produce Integrated Electronic Technical Manuals (IETM) deliverables. S2000M is the "International Specification for Material Management Integrated Data Processing for Military Equipment" and S1000D is the "International Specification for Technical Publications Utilizing a Common Source Database."

6.3 Principal Features of the Document

The main part of this document provides an overview of the intent of the ILS process by profiling the primary objectives found in MIL-STD-1388 1A and 2B. It is

also designed to integrate the use of the remaining parts of this standard as applied to the ILS process. The principal elements defined include: Design Influence, Maintenance Planning, Supply Support, Support and Test Equipment (S&TE), Reliability and Maintainability (R&M), Facilities, Manpower and Human Factors, Training and Training Equipment, Technical Documentation, Packaging, Handling, Storage and Transportation (PHS&T), and Non Operational Computer Resources (NOCR).

Other significant subjects that are addressed include data management, quality assurance and configuration management, business interfaces within ILS, ILS contract package and activities, and electronic information management. Additionally, Appendix C provides Logistics Analysis Record Relational Tables, LSAR Reports Summary, LSAR Reports/Relational Data Table Cross Reference Matrix, Example LSAR Output Report Illustrations, Index of Data Element Titles, Listing of Data element codes, and Data Element Dictionary.

A major thrust of this standard is the eventual establishment of the logistics support analysis process as an international standard that uses common data formats enabling communication and support among several organizations and countries.

6.4 Limitations/Tailoring Recommendations

As an overview and management document for the entire logistics support analysis process, this document can be applied to most any program and type of system or equipment. It is best applied beginning in the early planning stages of product development, and then throughout the remaining phases as needed to properly address the logistical issue of product support. Tailoring of the document will come with the selected application of the remaining logistics standards that fall under DSTAN 00-60. These standards are available as individual parts of DSTAN 00-60, such as Part 1, which is titled Logistic Support Analysis (LSA) and Logistic Support Analysis Record (LSAR).

CHAPTER 7: INT DSTAN 00-60 (PART 2) - INTEGRATED LOGISTIC SUPPORT: PART 2: GUIDE TO THE APPLICATION OF LSA AND LSAR

This document is dated 3 October, 1994, and contains 17 pages. Price: $37.00

7.1 Document Outline*

Preface

Section One. General

- 0 Introduction
- 1 Scope
- 2 Related Documents
- 3 Definitions
- 4 Abbreviations
- 5 LSA & LSAR

Section Two. Management

- 6 LSA & LSAR Management

Section Three. Application of LSA and LSAR to Projects

- 7 LSA Process
- 8 Tailoring
- 9 Data Transfer

7.2 Document Abstract

This part of DSTAN 00-60 provides general guidance on the use and application of the Logistic Support Analysis (LSA) and LSA Record (LSAR) process as they apply to procurement of military material. Guidance is given in relation to tasking found in MIL-STD-1388-1A & 2B and information provided in DSTAN 00-60, Part 0. The scope of the guidance covers not only new developments, but commercial-off-the-shelf (COTS) and Non-development items (NDI) and all life cycle phases.

7.3 Principal Features of the Document

The information provided is very useful to both government and contract program managers alike. Guidance is provided on expected outputs of specific LSA and LSAR tasking, management of specific tasks and when they are applicable. Specific guidance is provided on the management of LSA and LSAR, the LSA process (when and how to apply specific tasks found in MIL-STD-1388-1A & 2B), and the tailoring of requirements. In each guidance section, wording is accented with Figures and Tables to assist the user.

Section 6 provides a Figure showing the LSA feedback loop which depicts the entire LSA process across all phases. References are made to specific MIL-STD 1388 Task numbers, and feedback lines of communication are shown. Section 7, LSA Process, provides a figure showing the LSA process during equipment design. This figure is a flow diagram that clearly shows the steps and tasks required to develop a maintenance concept for a system or equipment. Tasking shown in this figure include: Failure Mode Effects and Criticality Analysis (FMECA), Reliability Centered Maintenance (RCM), Corrective and Preventative Maintenance, Support Resource Requirements, Level of Repair Analysis, and Maintenance Plans. Because the tasking found in MIL-STD-1388 is presented in how it relates to the DoD procurement phases, tables are also provided showing how the specific tasks relate to MOD procurement phases, which are different from those in the DoD. Specifically, task application tables are provided for full development projects, first-of-class warship projects, COTS projects, and NDI projects.

LSAR development and control is also discussed in Section 7, as is maintenance planning. This includes guidance on configuration management of the data, developing the LSA candidate list, availability of data, and depth of LSA tasking in relation to an equipment or system's work breakdown structure (WBS). Tailoring guidance is outlined in Section 8 and includes a list of considerations as follows: Phase of project, amount of design freedom involved, estimate on return of investment, time and resources available, work already done, past experience and availability of historical data, reports required from the LSAR, and in-service management information requirements. A figure showing a flow diagram of tailoring logic is also provided that can serve as tailoring guidelines for any LSA program.

7.4 Limitations/Tailoring Recommendations

The information presented is limited to LSA and LSAR programs only. The guidance is written to be applicable to all phases of a product's life cycle as well as for new developments, COTS and NDI. Tailoring of this document is not relevant, however, this document does provide a good deal of guidance on tailoring LSA and LSAR to individual projects across all equipment or system life cycle phases.

CHAPTER 8: BS 5760: PART 1: 1985 RELIABILITY OF CONSTRUCTED OR MANUFACTURED PRODUCTS, SYSTEMS, EQUIPMENTS AND COMPONENTS, PART 1. GUIDE TO RELIABILITY AND MAINTAINABILITY PROGRAMME MANAGEMENT

This document is dated 1985, and contains 34 pages. Price: $143.00

8.1 Document Outline

8.2 Document Abstract

Part 1 in a 15 part series, this part of BS 5760 is concerned with providing guidance on the development of reliability and maintainability program plans, quantitative reliability specifications, reliability assessment and prediction, and the collection and use of reliability data. The information presented is applicable to both hardware and software and covers all phases of the development cycle, including fielded systems.

8.3 Principal Features of the Document

Section Two of this document covers reliability and maintainability (R&M) program management. A table is provided up front that depicts the flow of tasks by development phase, including the relationships and dependencies of tasks within and across phases. Reference is made to the following tasks in the table, each of which is covered in paragraph 4 of the document (see outline above):

- Definition phase: Reliability feasibility study, Statement of reliability objectives and requirements, Reliability specification and contract formulation

- Design and development phase: Analysis of parts, materials and processes, Analysis of established and novel features, Failure mode, effects and criticality analysis, Incident sequence analysis (fault tree analysis), Stress and worst case analysis, Redundancy analysis, Human factors, Design change control, Design review, Design audit, Safety program, Maintainability program, Parts and sub-assembly testing, Performance testing, Environmental testing, Accelerated testing, Endurance testing, Reliability growth testing, Reliability demonstration, data collection, analysis and feedback

- Production phase: Preservation of reliability achievement, Quality conformance verification, Screening (run-in, bed-in, burn-in) of components and assemblies, Reliability demonstration, Additional software check

- Installation and commissioning: System acceptance testing, Commissioning tests, Quality assurance, Reliability growth, Reliability and maintainability demonstration, Data collection, Reliability and maintainability assessment

- Function and maintenance phase: Data collection, analysis and feedback, Redesign/modification, Maintenance

The write-ups on each task above provide a rationale for the task, task benefits and relationships or dependencies on other tasks. In addition to traditional R&M tasking, Human Factors and a Design Audit are also discussed. Specifically, human error is discussed in terms of communication errors during development among groups and management that can lead to degradation of reliability. Also, design errors that should be compensated for with quality checks and fault detection provisions, and potential errors caused by the system operator are also discussed. A design audit is also discussed and should be performed by an independent engineer.

Under reliability specification, the following items must be defined: system function(s), criteria for failure, appropriate reliability characteristic (e.g., MTBF, MTTF, etc.) and its required value and distribution of failures in time (if known), time and conditions under which items must function, and means by which reliability assurance is to be attained. The guide stresses the importance of defining quantitative specifications as opposed to qualitative ones. However, it is stated that the ability to define and assure quantitative values depends on knowledge of the physics of failure or actual test or field data.

Under assessment and prediction, the discussions deal primarily with the importance of data collection throughout development, analysis of failures and corrective actions. The guide discusses reliability growth programs in slightly different terms typically found in other documents. Rather than stressing the principles and statistical nature of a growth program, programmatic and cost factors are discussed such as knowing the testing support requirements, number of units allocated for testing, required test equipment, environmental chambers, ancillary service (e.g., special power supplies, cooling air), manpower (including maintenance of the test facilities) and supervision outside of normal hours. Other factors presented include providing for an active preparation period for defining test procedures, design and building of special test equipment, test chamber preparation time, and any required pre-conditioning or burn-in.

The final section discusses the need for accurate data collection throughout the system life cycle. In particular, the guide stresses communicating the importance of data through training, bulletins and discussions of the benefits of good data. Sources of data are discussed as is the design of a data collection system including data forms.

8.4 Limitations/Tailoring Recommendations

There are no limitations to the use of the information presented in this part of BS 5760. Several sections provide information that can easily be tailored in developing R&M program requirements and specifications for a reliability effort. The information is well organized in such a way as to facilitate tailoring. Comments are provided stating that not all information will be relevant to all programs, and the importance of defining end usage requirements for the system up front with the customer. Rationale and benefits of the tasking presented is provided that gives further guidance on tailoring. Note that other parts to BS 5760 provide details on how to perform each task, including techniques and mathematical equations.

CHAPTER 9: ARMP-1: EDITION 2: NATO REQUIREMENTS FOR RELIABILITY AND MAINTAINABILITY*

* Equivalent to British Ministry of Defence (MOD) Defense Standard 00-40: Part 1: Reliability and Maintainability Part 1: Management Responsibilities and Requirement for Programmes and Plans Issue 3.

This document is dated October 1993, and contains 23 pages. Price: $28.50

9.1 Document Outline

Para. 312	R&M Modelling
Para. 313	R&M Allocations
Para. 314	R&M Predictions
Para. 315	R&M Failure Modes, Effects and Criticality Analyses (FMECA)
Para. 316	Fault Tree Analysis
Para. 317	Sneak Analysis
Para. 318	The Impact of Software on R&M
Para. 319	Human Impact on R&M
Para. 320	Derating
Para. 321	Critical Items
Para. 322	Life Limited Items
Para. 323	R&M and Integrated Logistic Support
Para. 324	Data Classification
Para. 325	Data Reporting Analysis and Corrective Action System (DRACAS)
Para. 326	Reliability Growth Test (RGT) Programme
Para. 327	R&M Qualification Test Programme
Para. 328	Environmental Stress Screening (ESS)
Para. 329	Production Reliability Acceptance Test (PRAT) Programme
Para. 330	In-service R&M

Annex A Terminology

9.2 Document Abstract

This document provides general requirements for reliability and maintainability tasking necessary to achieve high availability material. The information presented is applicable to all phases of product procurement, including design, development, production and deployment, through tailoring of specific requirements described.

9.3 Principal Features of the Document

This standard is a classical example of an R&M requirements standard similar to MIL-STD-785 and MIL-STD-470. The tasks provided are meant to be tailored according to the specific system (including design level) and program requirements. Most, if not all of the classical R&M tasks, such as predictions, FMECA, modelling and allocations, failure reporting, analysis and corrective action systems (called Data reporting, analysis . . . in this standard), reliability growth, qualification testing, etc. are contained within this document. In all cases, the requirement is for the

contractor to plan and perform the task, but no requirement is provided for how the task shall be accomplished. In most cases, wording is provided that indicates exact methods will be agreed upon by the purchaser and developer.

In addition to the classical tasks mentioned above, this standard also lists analysis of software on R&M and analysis of the human impact on R&M. Further, an In-service R&M program is included that calls for tracking and assessment of R&M against predicted values early in the fielded phase of the product life cycle.

9.4 Limitations/Tailoring Recommendations

The task statements and general information contained within this document are applicable to any system or equipment to be procured. While a number of tasks are contained within this standard, not all will be applicable to every program or to every phase of a product's life cycle. While the wording within this document calls for tailoring of the tasks provided, no guidance on how to tailor is provided. Guidance in the application of the specific tasks is provided, however, in ARMP-2, General Application Guidance on the Use of ARMP-1, which is also reviewed in this report.

CHAPTER 10: NASA NHB 5300.4 (1A-1) - RELIABILITY PROGRAM REQUIREMENTS FOR AERONAUTICAL AND SPACE SYSTEM CONTRACTORS

This document is dated January, 1987 and contains 66 pages. Price: $54.50

10.1 Outline of Document

Preface

Chapter 1: Introduction

1A100	Scope
1A101	Approach
1A102	Relation to other contract requirements
1A103	Actions and prerogatives of the government
1A104	Reliability program requirements
1A105	Glossary of terms
1A106	Requirement for supplemental details to be specified

Chapter 2: Reliability Program Management

1A200	Organization
1A201	Reliability program plan
1A202	Reliability program control
1A203	Reliability progress reports
1A204	Reliability training
1A205	Supplier control
1A206	Use of previously designed, fabricated, or flown hardware
1A207	Reliability of government-furnished property (GFP)

Chapter 3: Reliability Engineering

1A300	General
1A301	Design specifications
1A302	Standardization of design practices
1A303	Reliability prediction
1A304	Failure Mode And Effects Analyses (FMEAs)
1A305	Part stress analyses
1A306	Worst-case analyses
1A307	Trend analyses
1A308	Special analyses
1A309	Software assurance
1A310	Maintainability/Serviceability and human induced failure
1A311	Electrical, electronic, and electromechanical (EEE) parts
1A312	Materials and processes
1A313	Review of electrical, electronic, and electromechanical (EEE) packaging
1A314	Design review program
1A315	Problem/failure reporting and correction

10.2 Document Abstract

This document presents both general and specific requirements for the planning and management of reliability for NASA contracts involving the design, development, fabrication, test, and/or use of aeronautical and space systems, including critical ground support equipment. Information provided covers allocation of these requirements to subcontractors by the prime system contractor.

10.3 Principal Features of the Document

This document provides general and specific information in four primary areas: program planning and reporting, specific reliability and reliability related tasking, reliability evaluation test program development and control, and problem/failure reporting and corrective action. In the area of reliability program planning, very detailed management requirements are provided including the development of organizational charts, by the contractor, that show responsibilities, interfaces and reliability documentation review and sign-off authority. This part of the document also requires stringent progress reporting, including day-to-day informal reporting of pertinent matters as they arise, written progress reports and a reliability program control report. The program control report is to provide resource data (e.g., comparison, for each task, of resources planned vs. resources expended for a particular reporting period). Subcontractor control is also emphasized and requirements are for the contractor to document those items to be provided by a subcontractor that require a reliability program plan, and justification on those that do not.

Within the section on reliability engineering, the document covers specific reliability tasks to be performed, as outlined above. For each task, specific guidance is given as to the types of information and goals of each task and suggestions for how the task data is to be used. In addition to classical reliability tasks such as the FMEA, predictions and modeling, the document also has requirements for analysis of materials and processes and packaging of EEE parts. These factors have a direct impact on the reliability of the systems being developed, and are therefore important to achieving high reliability.

The reliability testing program and problem/failure reporting and corrective action sections are similar in nature to other documents that cover the same subject areas. In addition to the above mentioned areas, this document allows for the use of existing components, subsystems, etc., in new developments. However, the contractor is required to show how such material meets the reliability specifications and requirements of the new system via a comparison of the previous material's requirements and specifications to those of the new one.

In addition to the above description, this document does a good job of stressing the need to coordinate with other functions to avoid duplication of effort. Appendix A of the document provides a cross reference matrix between this document and other related documents.

10.4 Limitations/Tailoring Recommendations

There are no major limitations in using this document for other, non-NASA procurements. The information contained within is meant to be tailored on an as needed basis, however, little to no guidance is given on how to tailor the information provided. As always, engineering judgment must be used for such tailoring. The data delivery and reporting requirements of this document are quite extensive and reflect NASA's emphasis on good planning, documentation and control. This document would therefore be quite effective on programs of higher risk and where reliability, safety and quality are important factors.

SECTION 10
REQUIREMENTS DEVELOPMENT AND ANALYSIS

PREFACE

The development of realistic and achievable requirements has always been an elusive part of R, M & A product development. Many studies conducted within the DoD community have dealt with how to translate user requirements in the field into achievable R, M & A requirements for development. Documents that provide insight into the important factors to analyze, such as the product's expected environmental profile, when developing requirements are extremely important. This guidance is needed early on in the product procurement phase and should be used by military program offices and commercial customers alike. The documents summarized within this section provide information on writing R&M requirements documents, development of requirements for R&M training, and on R&M procurement of off-the-shelf equipment. Any document that provides guidance in the procurement of commercial off-the-shelf (COTS) and Non-development Items (NDI) is of interest in the rapidly changing environment of DoD Acquisition Reform.

The US military documents that fall under the category of requirements development and analysis are listed below. All of the listed documents fall under other categories, and therefore the chapter within Section 11 where information on the document status under DoD Acquisition Reform is listed with the document.

- MIL-STD-2084 General Requirements for Maintainability (see Chapter 5 of Section 11)
- MIL-STD-1543 Reliability Program Requirements for Space and Launch Vehicles (see Chapter 8 of Section 11)
- MIL-STD-882 System Safety Program Requirements (see Chapter 9 of Section 11)
- MIL-STD-1388-2 DoD Requirements for Logistics Support Analysis Record (see Chapter 9 of Section 11)

Chapter 1 NATO **ARMP-4**, EDITION NO. 1
Guidance For Writing NATO R & M Requirements Documents

Chapter 2 NATO **ARMP-5**
Guidance On Reliability and Maintainability Training

Chapter 3 NATO **ARMP-6**
In-Service R & M

Chapter 4 NATO **ARMP-8**
Reliability & Maintainability in the Procurement of Off-The-Shelf Equipment

Chapter 5 INT DSTAN **00-60** (Part 1) - Integrated Logistics Support: Part 1: Logistic Support Analysis (LSA) and Logistic Support Analysis Record (LSAR)

Chapter 6 INT DSTAN **00-25** (Part 20) - Integrated Logistic Support: Part 20: Integrated Supply Support Procedures (ISSP)

Chapter 7 **BS 5760**: Part 4: 1986 Reliability of Constructed or Manufactured Products, Systems, Equipments and Components, Part 4. Guide To Specification Clauses Relating to the Achievement and Development of Reliability in New and Existing Items

CHAPTER 1: ARMP-4: EDITION NO. 1: GUIDANCE FOR WRITING NATO R&M REQUIREMENTS DOCUMENTS*

*Identical to British MOD Document DSTAN 00-40: Part 4 - Reliability and Maintainability Part 4: Guidance and Writing of NATO R&M Requirements Documents, Issue 1.

This document is dated April 1991, and contains 22 pages. Price: $29.00

1.1 Outline Of Document

Chapter 1 Introduction

Chapter 2 Concepts and Factors
- Para. 201 General
- Para. 202 Importance of using quantitative R&M requirements
- Para. 203 Need for traceability
- Para. 204 Confidence statements
- Para. 205 Selection of R&M parameters
  - A. General
  - B. System/equipment R&M parameters
  - B.1 Availability
  - B.2 Mission success
  - B.3 Maintenance manpower cost
  - B.4 Logistic support cost
  - C. Specifying R&M requirements
  - C.1 Reliability
  - C.2 Maintainability
- Para. 206 Duty cycles and environmental envelope
- Para. 207 The maintenance concept
- Para. 208 Definition of failure
- Para. 209 Sources of information

Chapter 3 Development of the R&M Concept of the PAPS Milestones
- Para. 301 General
- Para. 302 The R&M content of the NATO staff target
- Para. 303 The R&M content of the NATO staff requirement
- Para. 304 The R&M content of the NATO design & development objective and the design & development specification
- Para. 305 The R&M content of the NATO production objective and the production specification
- Para. 306 The R&M content of the NATO in-service goals
- Para. 307 The national disengagement intention

1.2 Document Abstract

This ARMP provides guidance on developing Reliability and Maintainability (R&M) requirements during the life cycle of a system development project. Although the project life cycle phases are based on the NATO Phased Armaments Programme System (NATO PAPS), the guidance is applicable to any development project. When appropriate, references to other ARMPs is provided for additional detail and explanation.

1.3 Principal Features of the Document

This document provides excellent guidance on the factors that need to be considered when developing R&M requirements for a system. The guidance stresses defining quantitative R&M requirements and provides several examples. The document also stresses that not all measures are applicable to all systems, and that a good deal of effort must be spent on defining the systems operational requirements, usage environments, and maintenance needs.

The guidelines presented in Chapter 2 - Concepts and Factors, provides examples of how other categories of operational parameters, such as Availability, Mission Success, Maintenance Manpower Costs, and Logistic Support Costs are affected by R&M requirements. Statements are made cautioning against applying the example R&M measures to all systems/equipments, and that the correct measures to be specified must be based on an analysis of all system requirements. Additional examples are provided on elements that need to be considered when developing R&M requirements such as environmental conditions, the maintenance concept, system duty cycles and definition of failures. Finally, the guidance section provides a list of information needed to support the R&M requirements definition process throughout the life cycle.

Chapter 3 - Development of the R&M Content of the PAPS Milestones, while being based on the PAPS system, is applicable to any program. Emphasis is put on pre-phase feasibility studies, conducted by the buyer, end user, and even current and potential contractors or suppliers, to properly define R&M requirements and tradeoffs. For each phase, types of studies that need to be completed are presented, as well as the expected outputs.

1.4 Limitations/Tailoring Recommendations

There does not appear to be any real limitations to this guidance document, other than it has been developed around the NATO PAPS process for defense systems/equipment. However, the principles and guidance presented can be used by commercial as well as military developers and procurement agencies. The guidance provided implies the need to tailor requirements, based on proper feasibility studies, trade-off analyses, and historical data (when it exists and is available).

CHAPTER 2: ARMP-5: GUIDANCE ON RELIABILITY AND MAINTAINABILITY TRAINING*

*Identical to British MOD Document DSTAN 00-40: Part 5 - Reliability and Maintainability Part 5: Guidance on R&M Training, Issue 1.

This document is dated May 1988, and contains 9 pages. Price: $24.50

2.1 Outline of Document

2.2 Document Abstract

This document provides guidance on the importance of R&M in the product development and procurement process and the emphasis that must be put on training both the buyer, including non-technical personnel, and the contractor in R&M principles and management.

2.3 Principal Features of the Document

Outlines who should receive training, and specifically states the kind of training that should be required for various levels of personnel. Two specific levels, Senior Management and Engineers, and Middle Level Management and Engineers are covered, including presentation of example outlines of R&M courses that could be given to each level. Annex A contains the example syllabus for Senior-level personnel and Annex B contains the syllabus (a 5-day course) for Middle-level personnel.

2.4 Limitations/Tailoring Recommendations

This document is limited to those personnel who are responsible for providing adequate R&M training to an organization. It is tailored to Senior and Middle-Level Managers and Engineers. No tailoring of this document is required, although a training course could be developed based on tailored versions of the example syllabus presented in the Annexes.

CHAPTER 3: ARMP-6: IN-SERVICE R&M*

*Identical to British MOD Document DSTAN 00-40: Part 6 - Reliability and Maintainability Part 6: In-Service R&M, Issue 1.

This document is dated May 1988, and contains 9 pages. Price: $24.50

3.1 Outline of Document

Chapter 1 Introduction
- Para. 101 General
- Para. 102 Scope
- Para. 103 Applicability
- Para. 104 Terminology
- Para. 105 Related Document

Chapter 2 General Requirements
- Para. 201 General
- Para. 202 Objectives of In-Service R&M Assessment
- Para. 203 In-Service R&M Assessment Plan

Chapter 3 Specific R&M In-Service Requirements
- Para. 301 General
- Para. 302 Data Collection
  - (a) Methods of Collection
  - (b) Data Set Requirements
  - (c) System/Equipment Data
  - (d) Operating Data
  - (e) Environmental Data
  - (f) Limits of Performance
- Para. 303 Data Analysis
- Para. 304 Further Service Trials and Demonstrations

3.2 Document Abstract

This document defines measures that should be considered when there is a need or a requirement for the preparation of an in-service R&M assessment plan that forms a part of the overall R&M plan for a specified system/equipment.

3.3 Principal Features of the Document

This document provides guidance in the development and definition of an In-Service R&M program designed to continue evaluation of a system's/equipment's R&M once it has been fielded. The document provides guidance on the various objectives of an In-Service program and the relevant kinds of information to be defined, collected and analyzed to meet those objectives.

In addition to general guidance on plan development, the document, in Chapter 3, provides more detailed guidance on methods of data collection, kinds of data to be collected such as the number of systems/equipments to be considered, and the specific operational and environmental data of importance. Finally, guidance on a data analysis system, including responsible organization and management is also provided.

3.4 Limitations/Tailoring Recommendations

This document has no limitations in terms of the kinds of systems or equipment it can be applied to. Wording within the document encourages tailoring to specific subsystems within a system, when this is appropriate. Therefore, it is not targeted specifically to any particular system level. As with other military handbooks and standards, this guide is also applicable to commercial systems that are continuously updated for the consumer markets, such as the automobile or commercial aerospace market. This document could be used as a guideline for establishing an in-house R&M data collection and assessment program designed to continuously enhance future generations of a specific product or products.

CHAPTER 4: ARMP-8: RELIABILITY & MAINTAINABILITY IN THE PROCUREMENT OF OFF-THE-SHELF EQUIPMENT*

*Identical to British MOD Document Reliability and Maintainability Part 8: Procurement of Off The Shelf Equipment, Issue 1.

This document is dated October 1991, and contains 13 pages. Price: $26.00

4.1 Outline of Document

Chapter 1 Introduction
- Para. 101 General
- Para. 102 Scope
- Para. 103 Applicability
- Para. 104 Terminology
- Para. 105 Related Document

Chapter 2 R&M Procurement Process of OTS Equipment
- Para. 201 General
- Para. 202 OTS Procurement Process Start
- Para. 203 Staff Requirement
- Para. 204 R&M Aspects of the Specification
- Para. 205 Market Investigation
- Para. 206 Decision to Proceed to Tender
- Para. 207 Final Programme Considerations

4.2 Document Abstract

This document outlines the measures to be taken for achieving an acceptable level of R&M in the purchase of Off-The-Shelf (OTS) equipment during all procurement stages, including the market investigation. It details the specific requirements that should be adopted by both the purchaser and contractor.

4.3 Principal Features of the Document

Provides a road map to the procurement of OTS equipment for military uses. A flow chart showing the major steps involved to deciding whether or not an OTS item exists for any particular program is provided. For each step outlined, specific guidance is given as to the process to be followed in evaluation of OTS R&M characteristics. This includes guidance from how to perform the market research to identify potential suppliers to the kinds of data that should be collected and

requested from said suppliers. Data collection areas covered include any previous R&M work, R&M qualitative and quantitative data, identification of any known critical and life limited items, logistics and maintenance information, software and cost.

4.4 Limitations/Tailoring Recommendations

This document was written primarily for those who procure military items and are faced with the prospect of buying off the shelf equipment. However, it is a good road map for any industry that wants to incorporate OTS items within a larger system, rather than contract for development. It can also be applied to any situation where an OTS item is being considered for an environment that the item was not designed for. Wording in this document implies that each of the guidelines presented must be tailored to any specific situation, and that not all factors presented will apply all the time.

CHAPTER 5: INT DSTAN 00-60 (PART 1) - INTEGRATED LOGISTIC SUPPORT: PART 1: LOGISTIC SUPPORT ANALYSIS (LSA) AND LOGISTIC SUPPORT ANALYSIS RECORD (LSAR)

This document is dated 3 October, 1994, and contains 13 pages. Price: $35.50

5.1 Document Outline*

5.2 Document Abstract

This part of INTERIM Defence Standard 00-60 makes reference to the United States (US) Military Standard MIL-STD 1388-1A & 2B which is the source document of application of logistic support in the MOD. It is to be read in conjunction with the referenced MIL-STD and with Part 0 of DSTAN 00-60. Annex A to this standard provides a cross link of definitions between the US DoD and the MOD.

5.3 Principal Features of the Document

This standard is a requirements development document of the application of LSA & LSAR to MOD procurements. It makes reference to both MIL-STD-1388-1A & 2B and Annex C of DSTAN 00-60, Part 0 for specific guidance on task performance.

Specifically, Section 5, Application, profiles the tasking provided for in MIL-STD-1388 and provides requirements for management of LSA data through the proper maintenance of the LSAR. Section 6 provides exclusions to specific parts of MIL-STD-1388 such as references to DoD Instructions, Federal Acquisition Regulations (FARs) and Defense Acquisition Regulations (DARs).

5.4 Limitations/Tailoring Recommendations

The use of this document should be as required for any MOD or other procurement. Wording is provided that states that MIL-STD-1388 is not designed for blanket application of all tasking and requirements. Section 9 of this standard provides tailoring guidance and states that tailoring is mandatory. Specific guidance on tailoring of the LSA and LSAR is provided in Part 2 of this Defence Standard. There are no primary limitations on the use of this standard, other than the exclusion clauses provided in Section 6 which are specific to non-DoD procurements.

CHAPTER 6: INT DSTAN 00-25 (PART 20) - INTEGRATED LOGISTIC SUPPORT: PART 20: INTEGRATED SUPPLY SUPPORT PROCEDURES (ISSP)

This document is dated 3 October, 1994, and contains 31 pages. Price: $43.00

6.1 Document Outline*

Preface

Section One. General
- 0 Introduction
- 1 Scope
- 2 Related Documents
- 3 Definitions

Section Two. Contractual Supply Support Elements
- 4 Principles and Standards for ISSP
- 5 Contracting for Supply Support

Section Three. Initial Provisioning
- 6 IP General
- 7 Data management
- 8 Electronic Data Interchange (EDI) Service Agreement for IP
- 9 NATO Codification
- 10 Illustrated Parts Catalogue

Section Four. Procurement Planning (to be issued)

Section Five. Order Administration (to be issued)

Section Six. Invoicing (to be issued)

Section Seven. Spares Consumption Data Exchange (to be issued)

Annex A	Supply Support Plan - Example Outline
Annex B	Use Study - Supply Support Aspects - Example Outline
Annex C	Statement of Work - Supply Support Aspects - Example Outline
Annex D	Data Element Cross-Reference List S2000M Chap 1/INT Def Stan 00-60
Annex E	Initial Provisioning Outline Service Agreement

6.2 Document Abstract

This part of Interim Defense Standard 00-60, Integrated Logistics Support, provides guidelines and requirements for the implementation of an integrated supply support plan when contracting for the procurement of defense equipment. This standard was issued as an interim standard and is to be applied to obtain information and experience of its application. Observations and comments are then collected from users, and the document is reviewed after 12 months for disposition.

6.3 Principal Features of the Document

The information provided in this standard represents guidelines in developing contractual documentation for the purpose of procuring supply support elements of a Logistics Support Analysis (LSA) program as discussed in Part 0 of this standard. Therefore, this document is to be used in conjunction with Part 0. Additional guidance is provided for the development of an Initial Provisioning (IP) plan, again in accordance or reference with Part 0.

Some emphasis is put on making the data elements produced as part of the supply support plan compatible with the Association Européene des Constructeurs de Matériel Aérospatial (AECMA) standard 2000m (S2000M), which is a standard for the interchange of data elements. S2000M's official title is "International Specification for Material Management Integrated Data Processing for Military Equipment." A cross reference list of Data Elements as referenced in this document with these data elements in S2000M is also provided as Appendix D.

The requirements of this standard are designed to incorporate requirements for NATO systems, such as requiring the use of the NATO Codification System (NCS). The NCS is designed to achieve maximum effectiveness in national and international logistic support, to facilitate data management in the area of materiel, and to identify items that appear to be different but meet the same requirement. This last item is accomplished by allocating each item of supply a NATO Stock Number (NSN).

6.4 Limitations/Tailoring Recommendations

The use of this document is limited to the application and planning of an integrated logistics support plan as it pertains to integrated supply support procedures (ISSP). It can be applied to any system or equipment that requires such planning. There are no specific tailoring guidelines within this document, although there may be in other parts of the standard, such as Part 0.

CHAPTER 7: BS 5760: PART 4: 1986 RELIABILITY OF CONSTRUCTED OR MANUFACTURED PRODUCTS, SYSTEMS, EQUIPMENTS AND COMPONENTS, PART 4. GUIDE TO SPECIFICATION CLAUSES RELATING TO THE ACHIEVEMENT AND DEVELOPMENT OF RELIABILITY IN NEW AND EXISTING ITEMS

This document is dated 1986, and contains 18 pages. Price: $109.50

7.1 Document Outline

Foreword

Committees responsible

Section One. General
1. Scope
2. Definitions

Section Two. The Need for Reliability Specifications
- 2.1 Diversity of requirements
- 2.1.1 Originator and user requirements
- 2.1.2 Purchaser and supplier requirements
- 2.1.3 Marketing, design, manufacturing and construction requirements
- 2.2 Nature of the product
- 2.2.1 Manufactured products
- 2.2.2 Constructed products
- 2.2.3 End-items and components
- 2.2.4 Repairable and non-repairable items
- 2.2.5 Systems designed from existing components
- 2.2.6 Revolutionary and evolutionary designs
- 2.2.7 Development and modification of existing products
- 2.3 Nature of the market
- 2.3.1 Supplier specifies
- 2.3.2 Supplier specifies with purchaser's option to test
- 2.3.3 Supplier specifies with purchaser-specified modifications or features
- 2.3.4 Purchaser specifies

Section Three. The Specification of Reliability
- 3.1 Introduction to reliability
- 3.1.1 Causes of unreliability
- 3.1.2 The traditional treatment of reliability
- 3.1.3 Elements of reliability clauses
- 3.1.4 Quantitative reliability clauses
- 3.1.5 Problems in applying the quantitative approach
- 3.1.6 The qualitative approach
- 3.1.7 Specification of reliability for systems containing software
- 3.2 Reliability clauses in a specification

7.2 <u>Document Abstract</u>

Part 4 in a 15 part series, this part of BS 5760 is concerned with providing guidance information on the purpose, content and types of reliability specifications

and requirements that can be developed for both new and existing products. Specific guidance is provided for reliability clauses that should be contained in a specification, reliability program management, and program management functions that should include attention to reliability issues. Maintenance and availability are also addressed as part of this document

7.3 Principal Features of the Document

As with other parts of BS 5760, part 4 is designed to be used in conjunction with other parts, Part 1 in this case. (BS 5760 Part 1 is the guide to reliability and maintainability program management.) The guide is applicable to both military as well as commercial products. Section 2 is very useful in that information is presented on the different market forces that will drive the need or importance of reliability. Reliability requirements as they relate to the nature of the product, user requirements, purchaser and supplier requirements, and more specifically, marketing, design manufacturing and construction requirements are presented in Section 2. Section 2 also provides a figure depicting the various kinds of specifications and their reliability content. This provides an excellent overview of the specifications to be considered as part of an equipment development program and what role reliability could play in each. The following specifications are covered in the figure: Target (storage and use conditions), Function, Product, Materials, Process, Inspection, Test, Acceptance, Handling, Storage and Transport, Installation (manual, not a specification), Use (manual), Maintenance (manual), and Disposal (Notice). The figure provides a tailorable list of reliability and maintainability issues to be considered.

The remainder of the guide presents information on specific tasking to be considered in a reliability development program, including both quantitative and qualitative tasks (Section 3), and a checklist of clauses to be considered when developing a reliability specification (Section 4). Both hardware and software issues are covered, as well as all phases of development, including testing, fielded items and disposal. The final parts of the guide mention the need to integrate reliability with other program management tasks, including quality assurance functions. The Appendices provide an example reliability program specification (Appendix A) and a quantitative reliability performance specification that includes availability and maintainability. Both of these appendices provide a tailorable specification that can be used as a baseline for many programs.

7.4 Limitations/Tailoring Recommendations

There are no limitations to the use of the information presented in this part of BS 5760. Several sections provide information that can easily be tailored in developing requirements and specifications for a reliability effort. With the information presented on marketing and product nature, this guide can be used for both military as well as commercial developments.

SECTION 11
US MILITARY SPECIFICATION CHANGES
RESULTING FROM ACQUISITION REFORM

Acquisition Reform Background

Defense Acquisition Reform is an initiative intended to restructure the DoD weapon system procurement process by minimizing government oversight and increasing reliance on commercial products and practices. Implementation of the reform will result in fewer military specifications and standards, and increase reliance on nongovernment standards. Military specifications will become "performance based" leaving out "how to" information, thus giving the manufacturer more latitude to determine how to meet the user requirements. Military handbooks will still be available, however, their use as "guidance only" will be emphasized. Defense acquisition reform fundamentally changes the way DoD does business.

Impact of Acquisition Reform upon Military Specifications

In June 1994, Secretary of Defense Perry issued a memorandum Titled "Specifications and Standards - A New Way of Doing Business." A central objective of this new way is to move towards a unified commercial/military industrial base. The following are the three main goals of Military Specifications and Standards Reform:

- Eliminating non-value added, military unique requirements and procedures
- Taking advantage of commercial technology and process advancements
- Facilitating defense firms' diversification into commercial markets

Dr. Perry's memorandum outlines procedures for overhauling the military standardization process. It calls for the elimination of excessive contractual requirements and the implementation of new management approaches. It recommends the adoption of performance based specifications as a means of acquiring and modifying weapon systems. It prohibits citing military specifications, and standards in solicitations unless a waver is granted. Nongovernment standards and commercial item descriptions are also recommended for use if at all practical.

In short, the memorandum attempts to prevent program managers from indiscriminately requiring Mil-Specs, thereby saving money and removing barriers to acquiring commercial products and state-of-the-art technology for military systems.

Secretary of Defense Perry's memorandum encourages the formation of partnerships with industrial associations to develop nongovernment standards where practicable. A number of the documents scheduled to replace military standards are being prepared by such groups. Specific mention is made within this section where such groups have been chartered to prepare replacement documents.

Organization of Section 11

Within Section 11, the historic R & M military standards are grouped into chapters using the same general categories as were used throughout the document. This was done to assist the reader in determining those documents most severely effected by defense acquisition reform, to learn the specific action being taken with respect to each document and to give additional insight as to potential alternate nongovernment documents.

Chapter 1 Vocabularies/Glossaries/Terms and Parameters
- MIL-STD-721 Definitions of Terms for Reliability and Maintainability

Chapter 2 Design Guides and Handbooks
- MIL-HDBK-338 Electronic Reliability Design Handbook
- MIL-STD-454 Standard General Requirements for Electronic Equipment

Chapter 3 Analysis Techniques
- MIL-HDBK-217 Reliability Prediction of Electronic Equipment
- MIL-STD-756 Reliability Modeling and Prediction
- MIL-STD-1629 Procedures for Performing a Failure Mode Effects and Criticality Analysis
- MIL-STD-2165 Testability Program for Electronic Systems and Equipments

Chapter 4 Testing
- MIL-STD-781 Reliability Testing for Engineering Development, Qualification and Production
- MIL-STD-810 Environmental Test Methods and Engineering Guidelines
- MIL-STD-1635 Reliability Growth Tests
- MIL-STD-2068 Reliability Development Tests

MIL-STD-2074	Failure Classification for Reliability Testing
MIL-STD-2164	Environmental Stress Screening Process for Electronic Equipment

Chapter 5 Maintainability

MIL-STD-470	Maintainability Program for Systems and Equipments
MIL-STD-471	Maintainability Demonstration
MIL-STD-2084	General Requirements for Maintainability

Chapter 6 Data Collection and Parts Information

MIL-STD-690	Failure Rate Sampling Plans and Procedures
MIL-STD-757	Reliability Evaluation for Demonstration Data
MIL-STD-790	Reliability Assurance Program for Electronic Parts Specifications
MIL-STD-883	Test Methods and Procedures for Microelectronics
MIL-STD-965	Parts Control Program
MIL-STD-1840	Automated Interchange of Technical Information
MIL-M-38510	General Specification for Microcircuits
MIL-H-38534	General Specification for Hybrid Microcircuits
MIL-I-38535	General Specification for Integrated Circuits (Microcircuits) Manufacturing

Chapter 7 Product/Industry Specific Documents

MIL-STD-1686	Electrostatic Discharge Control Program for Protection of Electrical and Electronic Parts, Assemblies and Equipment

Chapter 8 Management

MIL-STD-785	Reliability Program for Systems and Equipment Development and Production
MIL-STD-1543	Reliability Program Requirements for Space and Launch Vehicles
MIL-Q-9858	Quality Program Requirements

Chapter 9 Logistics and Safety-Related Specifications

MIL-STD-882	System Safety Program Requirements
MIL-STD-1388-1	Logistics Support Analysis
MIL-STD-1388-2	DoD Requirements for Logistics Support Analysis Record
MIL-STD-1390	Level of Repair Analysis

Defense Acquisition Reform WWW Information Sources

The World Wide Web (WWW) is an excellent source for timely information regarding defense acquisition reform. The preferred gateway for this type of information is the Defense Standardization Program Home Page (http://www.acq.osd.mil/es/std/stdhome.html).

Some additional specific WWW locations of interest are as follows:

Document Improvement Actions
http://www.acq.osd.mil/es/std/improve.html

Policy Memos and other Guidance
http://www.acq.osd.mil/es/std/stdmemo.html

Frequently Asked Questions
http://www.acq.osd.mil/es/std/stdfaq.html

The Standardization Newsletter
http://www.acq.osd.mil/es/std/newslet.html

The Heartburn Documents
http://www.acq.osd.mil/es/std/hartburn.html
(approximately 105 documents) (also available as a Word 6 file) (.doc)

Summary of Results
http://www.acq.osd.mil/es/std/summary.html
(document changes implemented) (also available as a Word 6 file) (.doc)

Acquisition Practices
http://www.acq.osd.mil/es/ia/ap.html

Industrial Affairs Home Page
http://www.acq.osd.mil/es/ia/iahome.html

For specific information about the acquisition of commercial or nondevelopmental items contact:

Nondevelopmental Items Home Page
http://www.acq.osd.mil/es/std/ndihome.html

To obtain information regarding the DoD Index of Specifications and Standards (DoDISS) or to order military specifications, standards or handbooks from the Standardization Documents Order Desk contact:

DoD Single Stock Point
http://www.dtic.dla.mil:80/ps-phila/

For those without WWW access, the standardization program office address is:

Defense Standardization Program
5203 Leesburg Pike, Suite 1403
Falls Church, VA 22041-3466

CHAPTER 1: VOCABULARIES/GLOSSARIES/TERMS AND PARAMETERS SPECIFICATION CHANGES RESULTING FROM ACQUISITION REFORM

MIL-STD-721 Definitions of Terms for Reliability and Maintainability

MIL-STD-721 was canceled on December 5, 1995 with no replacement. Any contents of the document deemed valuable will be retained in MIL-HDBK-338.

CHAPTER 2: DESIGN GUIDE AND HANDBOOK CHANGES RESULTING FROM ACQUISITION REFORM

MIL-HDBK-338-1 Electronic Reliability Design Handbook, Vol. I

Notice 1, dated June 14, 1995, clarifies that the document is "For Guidance Only."

MIL-HDBK-338-2 Electronic Reliability Design Handbook, Vol. II

Notice 1, dated June 14, 1995, clarifies that the document is "For Guidance Only."

MIL-STD-454 Standard General Requirements for Electronic Equipment

MIL-STD-454 has been canceled by Notice 4, dated May 4, 1995 and has been replaced by MIL-HDBK-454, dated April 28, 1995. EIA 645, currently under development is planned as a replacement.

MIL-STD-5400 General Specification for Aerospace Electronic Equipment

MIL-STD-5400 was converted to a Handbook in November 1995.

CHAPTER 3: ANALYSIS TECHNIQUE SPECIFICATION CHANGES RESULTING FROM ACQUISITION REFORM

MIL-HDBK-217 Reliability Prediction of Electronic Equipment

MIL-HDBK-217 is scheduled to be retained as a handbook until a suitable Non-Government Standard is available for use. A change notice is to be issued clarifying that it is to be for guidance only and not to be used as a contractual document.

MIL-STD-756 Reliability Modeling and Prediction

MIL-STD-756 is scheduled to be canceled with no replacement. Any contents of the document deemed valuable will be retained in MIL-HDBK-338.

MIL-STD-1629 Procedures for Performing a Failure Mode Effects and Criticality Analysis

MIL-STD-1629 is scheduled to be canceled after the publication of a suitable Non-Government Standard. The SAE is presently working on a replacement standard. The Defense Standardization Improvement Council (DSIC) had requested that the SAE attempt to publish the industry standard by June 1996.

MIL-STD-2165 Testability Program for Electronic Systems and Equipments

MIL-STD-2165 was canceled as a Military Standard and redesignated as a Military Handbook by Notice 1 dated 31 July 1995.

CHAPTER 4: TESTING SPECIFICATION CHANGES RESULTING FROM ACQUISITION REFORM

MIL-STD-781 Reliability Testing for Engineering Development, Qualification and Production

MIL-STD-781 is scheduled to be canceled after incorporation of the relevant material into the existing MIL-HDBK-781. DSIC is planning to request assistance in locating or developing a suitable industry standard.

MIL-STD-810 Environmental Test Methods and Engineering Guidelines

MIL-STD-810 has been retained as a Test Method Standard effective with Notice 3 dated July 3, 1995. DSIC is seeking ANSI's assistance in identifying help to develop industry standards that are suitable for replacing all or parts of this document.

MIL-STD-1635 Reliability Growth Tests

MIL-STD-1635 is scheduled for cancellation.

MIL-STD-2068 Reliability Development Tests

MIL-STD-2068 has been canceled without replacement effective with Notice 1 dated 20 March 1995.

MIL-STD-2074 Failure Classification for Reliability Testing

MIL-STD-2074 has been canceled with no replacement. Any contents of the document deemed valuable will be retained in MIL-HDBK-338.

MIL-STD-2164 Environmental Stress Screening Process for Electronic Equipment

MIL-STD-2164 has been canceled as a Military Standard and redesignated as a Military Handbook.

CHAPTER 5: MAINTAINABILITY SPECIFICATION CHANGES RESULTING FROM ACQUISITION REFORM

MIL-STD-470 Maintainability Program for System and Equipments

As an interim measure, MIL-STD-470 has been canceled as a Military Standard and has been redesignated as a Military Handbook by Notice 1, dated June 12, 1995. The plan is to consolidate this document with MIL-STD-471 and publish the combined document as a new handbook by January 1997.

MIL-STD-471 Maintainability Demonstration

As an interim measure, MIL-STD-471 has been canceled as a Military Standard and has been redesignated as a Military Handbook by Notice 1, dated June 12, 1995. The plan is to consolidate this document with MIL-STD-470 and publish the combined document as a new handbook by January 1997.

MIL-STD-2084 General Requirements for Maintainability

MIL-STD-2084 has been canceled as a Military Standard and has been redesignated as a Military Handbook by Notice 3, dated July 31, 1995.

CHAPTER 6: DATA COLLECTION AND PARTS SPECIFICATION CHANGES RESULTING FROM ACQUISITION REFORM

MIL-STD-690 Failure Rate Sampling Plans and Procedures

MIL-STD-690 is still an active document.

MIL-STD-757 Reliability Evaluation for Demonstration Data

MIL-STD-757 is planned for cancellation.

MIL-STD-790 Reliability Assurance Program for Electronic Parts Specifications

MIL-STD-790 was converted to a Standard Practice document on August 1, 1995 and is still active.

MIL-STD-883 Test Methods and Procedures for Microelectronics

MIL-STD-883 is to be retained as a Test Method Standard until a suitable Non-Government Standard is available for use.

MIL-STD-965 Parts Control Program

MIL-STD-965 is in the process of being rewritten.

MIL-STD-1840 Automated Interchange of Technical Information

MIL-STD-1840 has been redesignated as an Interface Standard by DSIC Chair memorandum, dated March 15, 1995.

MIL-M-38510 General Specification for Microcircuits

MIL-M-38510 was reclassified to inactive for new design in 1993. It has been superseded by QML document MIL-PRF-38535, a performance specification, dated March 14, 1995.

MIL-H-38534 **General Specification for Hybrid Microcircuits**

MIL-H-38534 has been converted to a performance specification, MIL-PRF-38534.

MIL-I-38535 **General Specification for Integrated Circuits (Microcircuits) Manufacturing**

MIL-I-38535 has been converted to a performance specification, MIL-PRF-38535, dated March 14, 1995.

CHAPTER 7: PRODUCT/INDUSTRY SPECIFIC SPECIFICATION CHANGES RESULTING FROM ACQUISITION REFORM

MIL-STD-1686 Electrostatic Discharge Control Program for Protection of Electrical and Electronic Parts, Assemblies and Equipment

MIL-STD-1686 is scheduled to be converted to a Standard Practice document and used as such until a suitable Non-government standard is published.

CHAPTER 8: MANAGEMENT SPECIFICATION CHANGES RESULTING FROM ACQUISITION REFORM

MIL-STD-785 **Reliability Program for Systems and Equipment Development and Production**

MIL-STD-785 is scheduled to be canceled after the publication of a suitable Non-Government Standard. The IEEE is presently working on a replacement standard. The Defense Standardization Improvement Council (DSIC) had requested that the IEEE attempt to publish the industry standard by June 1996. An SAE Standard is also complete and a DoD adoption process was initiated.

MIL-STD-1543 **Reliability Program Requirements for Space and Launch Vehicles**

MIL-STD-1543 is scheduled to be canceled after the publication of a suitable Non-Government Standard. This action will occur simultaneously with the replacement of MIL-STD-785.

MIL-Q-9858 **Quality Program Requirements**

This document was canceled in October 1996.

CHAPTER 9: LOGISTICS AND SAFETY-RELATED SPECIFICATION CHANGES RESULTING FROM ACQUISITION REFORM

MIL-STD-882 System Safety Program Requirements

MIL-STD-882 is to be retained until a suitable Non-Government Standard is available for use.

MIL-STD-1388-1 Logistics Support Analysis

MIL-STD-1388-1 is scheduled to be canceled as a Military Standard and redesignated as a Military Handbook.

MIL-STD-1388-2 DoD Requirements for Logistics Support Analysis Record

MIL-STD-1388-2 was scheduled to be canceled after conversion to a Data Specification by June 1996.

MIL-STD-1390 Level of Repair Analysis

MIL-STD-1390 was scheduled to be canceled as a Military Standard and redesignated as a Military Handbook by June 1996.

SECTION 12
PROFESSIONAL STANDARDS DEVELOPMENT WORK IN PROGRESS

CHAPTER 1: IEC STANDARDS DEVELOPMENT WORK IN PROGRESS

IEC **300-3** - DEPENDABILITY MANAGEMENT PART 3: APPLICATION GUIDE

Section 1: Analysis Techniques for Dependability: Guide on Methodology, "Contains a number of Application Guides which develop the tasks in IEC 300-2, "Dependability Management - Part 2: Dependability Programme Elements and Tasks." These guides then lead to further documents which describe the individual "tools" which can be used when applying a Guide. Two new guides are presently being prepared for inclusion in this series.

IEC **300- 3-NN** - APPLICATION GUIDE FOR RELIABILITY TESTING

The draft guide is dated March, 1995 and contains 74 pages.

This document is an updated version of the old document 605-1, "Equipment Reliability Testing - Part 1: General Requirements." It has been rewritten as an application guide for the series of documents on Reliability Testing. This new Guide contains only general information which is necessary to select the correct International Standard for Reliability testing as well as for planning and performing tests. Details of the methods themselves can be found in the corresponding International Standard for Reliability testing.

IEC **300-3-X** - MAINTAINABILITY APPLICATION GUIDE

The draft guide is dated November, 1994 and contains 36 pages.

This new Application Guide for Maintainability can be used to implement a Maintainability Program covering the initiation, development and in-service phases of a product. It provides guidance on how the maintenance aspects of the tasks should be considered in order to achieve optimum maintainability. The new Guide is intended to be used in conjunction with the relevant sections of IEC 706, "Guide on Maintainability of Equipment" as "tools".

In addition to the above descriptions, the following table presents other standards development projects currently in-progress within the IEC Technical

Committee (TC) - 56, which is responsible for the area of dependability. The status codes listed in the second column of the table are as follows:

DIS - Draft International Standard, which means that it can be purchased

Com - means that it is still in committee and not ready for release

ANW - A New Work that is still in the very early stages of development with little written down

DOCUMENT NUMBER	DOCUMENT STATUS	DOCUMENT TITLE
300-3-4	DIS	Dependability Management Guide To The Specification Of Dependability Requirements
300-3-5	Com	Application Guide
300-3-6	Com	Software Aspects Of Dependability
300-3-7	Com	Reliability Stress Screening Of Electronic Hardware
300-3-10	Com	Human Reliability
300-3-11	Com	Reliability Centered Maintenance
300-3-12	ANW	Integrated Logistic Support
300-3-13	ANW	Technical Risk Management
605-3-6	DIS	Equipment Reliability Test: Preferred Test Conditions, Transportable Equipment, Low Degree Of Simulation
605-4	Com	Point Estimate And Confidence Intervals For The Exponential Distribution
605-6	DIS	Tests For The Validity Of The Constant Failure Rate Or Constant Failure Intensity Assumptions
1124	DIS	Reliability Testing - Compliance Tests For Constant Failure Rates And Constant Failure Intensity
1163-2	Com	Guide For Reliability Stress Screening Components
1649	DIS	Procedures For Goodness-Of-Fit Tests, Confidence Limits For Weibull Distribution Data
1650	DIS	Practical Reliability Analysis Techniques - Procedures For Comparison Of Two Constant Failure Rates And Two Constant Failure (Event) Intensities
1704	Com	Mathematical Expression Of Intensity

DOCUMENT NUMBER	DOCUMENT STATUS	DOCUMENT TITLE
1709	DIS	Guide To Test Methods For Dependability Assessment Of Software
1710	Com	Goodness-Of-Fit For The Power Law Model
1713	Com	Guide To Software Dependability Through The Software Life Cycle Process
1714	Com	Software Maintainability And Maintenance Aspects Of A Dependability Programme
1719	ANW	Dependability Of Software For Critical Applications
1882	ANW	Guide For Hazard And Operability Studies.

Further details about any of the above standards projects can be obtained by sending a specific question via email to Donna Nelson at IEC headquarters. Ms. Nelson's email address is:

Nelson_Donna/CO@iec.ch

CHAPTER 2: INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE) PROFESSIONAL STANDARDS DEVELOPMENT WORK IN PROGRESS

The IEEE has several on-going standards development projects in a number of areas. A list of all projects and standards, existing, new starts or re-issuance, can be found on the world wide web at URL:http://stdsbbs.ieee.org. Once there, follow the link to products and then to the quarterly status report, which provides the list. Those standards projects in the area of dependability and other relevant areas are listed below, including the point of contact. If a draft is available, this is noted with pricing information and order number.

STANDARD PROJECT NUMBER	TITLE	POINT OF CONTACT	NOTES
933	Guide for Definition of Reliability Program Plans	J.R. Fragola Phone: 212-661-5780	Draft, Revision D9 $30.00 $23.50 (IEEE member) Order # DS1453
982.1	Standard Dictionary of Measures to Produce Reliable Software	James H. Dobbins Phone: 703-664-3475	
1082	Human Action Reliability Analysis	D. Shurman Phone: 208-528-2105	
1415	Guide for Induction Machinery Maintenance Testing and Failure Analysis	Larry Wall Phone: 205-870-6354	
1413	Standard Methodology for Reliability Predictions and Assessment for Electronic Systems Equipment	Michael Pecht Phone: 301-405-5323	
1233	Guide to Developing System Requirements Specifications	Louis E. Miller Phone: 313-248-5591	Draft, Revision D2 $34.00 $27.00 (IEEE member) Order # DS01776
1240	Guide for Reliability of HVDC Converter Stations	Farshad J. Hormozi Phone: 213-481-4836	
1332	Standard Reliability Program for the Development and Production of Electronic Systems and Equipment	Michael Pecht Phone: 301-405-5323	
1366	Guide of Terms and Definitions Associated with Distribution Reliability and Their Application	Cheryl A. Warren Phone: 518-395-5102	
1389	Standard for the Management of Test and Maintenance Information	Peter Lord Phone: 513-445-4735	

CHAPTER 3: SOCIETY OF AUTOMOTIVE ENGINEERS INTERNATIONAL (SAE) PROFESSIONAL STANDARDS DEVELOPMENT WORK IN PROGRESS

The SAE G-11 committee is known as the SAE International Reliability, Maintainability, Supportability, and Logistics (RMSL) Committee. The scope of this committee has grown from strictly aerospace and defense to encompass air, land and space technologies. There are currently several standards projects within G-11 that have been organized to develop standards in a specific area. The table below provides a list of on-going standards development by standard title, and standard development team leader.

STANDARD PROJECT TITLE	STANDARD DEVELOPMENT TEAM LEADER
FMEA/FMECA Task Standard	John Bowles, University of South Carolina phone: (803) 777-2689 fax: (803) 777-8045 email: bowles@ece.scarolina.edu
Supportability Process Standard	Howard Hetrick, Northrop Grumman phone: (805) 540-0545 fax: (805) 272-6580 email: MFJW44A@prodigy.com
Scheduled Maintenance Standard	Tom Nondorf, McDonnell Douglas Corp. phone: (314) 234-5092 fax: (314) 234-6934 email: tnondorf@gwsmtp01.mdc.com
Reliability Testing Standard	Bill Grimes, Texas Instruments Inc. phone: (214) 952-5844 fax: 214-952-5771 email: bgrimes@ti.com
Reliability Process Standard	Ivan Boivin, United Technologies Corp. phone: 313-240-3214 fax: 313-593-9580 email: jboivin@uta.com
Maintainability Process Standard	Jim Brunke, Rockwell International phone: 310-797-1395 fax: 310-797-3714 email: jgbrunke@ix.netcom.com
Electronic Reliability Analysis & Prediction	David Followell, McDonnell Douglas
Solid Propulsion Reliability	Ron Adib, United Technologies Corp.
Mechanical Reliability Analysis & Prediction	Jack Redman, Allied Signal Inc.
Safety & Reliability Analysis Integration	Dave Saunders, General Electric Co.
Maintainer Simulation	Mike Biferno, McDonnell Douglas
Probabilistic Methods Design	Eric Fox, United Technologies Corp.
Probabilistic Methods Applications	Mohammad Khalessi, Rockwell International
Probabilistic Methods Technology Transfer	Tony D'Angelo, U.S. Department of Army
Probabilistic Methods Legal Issues	Ellie Azhaang, Advanced Probabilistic Research Inc.
Probabilistic Methods Cultural Barriers	Chris Pomfret, U.S. Department of Air Force
Probabilistic Methods Liaison & Resources	Magdy Riskalla, Northrop Grumman
RMSL Guidebook	Loretta Arellano, Hughes Aircraft Co.

For detailed information on the status of any of the above projects, or to find out how to become involved, contact the SAE at the address, phone number, or internet address listed for the SAE in Appendix A.

CHAPTER 4: AIR TRANSPORT ASSOCIATION (ATA) PROFESSIONAL STANDARDS DEVELOPMENT WORK IN PROGRESS

The ATA is currently working on two dependability related standards. Each of these efforts are described below.

Maintenance Control by Reliability Methods

The Point of Contact (POC) for this standard effort is D. Lotterer. Mr. Lotterer can be reached via telephone at (202) 626-4036, fax at (202) 626-4081, or via e-mail at davelott@aol. com. As of March 1996, revisions to this document were submitted to the Federal Aviation Administration (FAA) for adoption. This standard is an FAA advisory type of document that provides guidance for the development of programs using reliability techniques.

Maintenance Program Development

This standards project is being prepared by the Maintenance Steering Group - 3 Task Force of the ATA. The POC is D. Letterer (see above). The primary purpose of this document is to develop a proposal to assist the Regulatory Authority in establishing an initial scheduled maintenance program for new systems. Work is in progress and participation is still welcome.

CHAPTER 5: SOCIETY OF LOGISTICS ENGINEERS (SOLE) PROFESSIONAL STANDARDS DEVELOPMENT WORK IN PROGRESS

The SOLE is currently working of at least two dependability related standards. Each of these standards efforts are described below.

In-Service Logistics Demonstration (Guidelines)

The team leader for this project is Mr. David L. Place. Mr. Place can be contacted by phone at (540) 549-5513 or by e-mail at place@doim6.monmouth.army.mil. This standard is currently in the "Determination of Need" phase, and SOLE is calling for participation in this effort. The focus for this standard will be guidelines for data collection and analysis of controlled markets, product warranty data or operationally oriented tests. These data sources are useful for quantifying and validating supportability. Additional participation is currently being solicited by SOLE.

Re-Engineering Supportability

The team leader for this project is Mr. Charles O. Coogan and is being sponsored by the SOLE Ad Committee. Mr. Coogan's e-mail address is ccoogan@alc.com. One focus of this project is the participation with the Society of Automotive Engineers (SAE) on the development of a joint commercial supportability standard. To date, the committee has baselined 34 commercial and military supportability programs, identified common problems, developed a set of supportability analysis principles, and organized a six-step approach to Performance Based Supportability.

CHAPTER 6: US MILITARY

In addition to the previously discussed commercial standards projects, the U.S. DoD has other RMA&D handbook development projects currently planned or in-progress.

MIL-HDBK-781. "Reliability Test Methods, Plans, and Environments for the Engineering Development, Qualifications, and Production

This project is being sponsored by U.S. Navy Space and Warfare Systems Command, SPAWAR 10-12. The project lead is Mr. Bob Kolacki. The project objective is to incorporate MIL-STD-781, being canceled under DoD Acquisition Reform, into MIL-HDBK-781.

Mr. Kolacki can be reached at (703) 602-9142 (commercial), or DSN: 332-9142, or by email at kolacki@smtp.gw.spawar.navy.mil

A New Military Maintainability Handbook

This project is being sponsored by the US Air Force Rome Laboratory. The project lead is Mr. Joe Caroli. The objective of this project is to create a handbook to replace MIL-STD-470, Maintainability Program for Systems and Equipment, and MIL-STD-471, Maintainability Verification/Demonstration/Evaluation. A draft copy of the handbook is available on the Reliability Analysis Center's WWW page at http://rome.iitri.com/RAC. Mr. Caroli can be reached at (315) 330-4205 or by email at carolij@rl.af.mil.

Revision to MIL-HDBK-338, "Electronic Reliability Design Handbook"

This project is also being sponsored by Rome Laboratory and led by Mr. Caroli. MIL-HDBK-338 is being revised to incorporate new developments in reliability technology. The new revision will include acquisition guidance for customers and suppliers in the post acquisition reform era. The general focus of the handbook is reliability design, engineering, prediction, analysis, testing, etc.

APPENDIXES

APPENDIX A: STANDARDS ORGANIZATIONS WITHIN THE UNITED STATES

AIA/NAS - Aerospace Industries Association of America/National Aerospace Standards

1250 Eye Street, NW
Washington, DC 20005

Tel: (202) 371 8400
Fax: (202) 371 8470

AIAA- American Institute of Aeronautics and Astronautics

370 L'Enfant Promenade, SW
Washington, DC 20024

Tel: Within the US: (800) 639-2422
Outside the US: (202) 646-7400
Fax: (202) 646-7508
email: custserv@aiaa.org

ANSI - American National Standards Institute

11 West 42nd Street
New York, NY 10036

Tel: (212) 642-4900
Fax: (212) 302-1286
World Wide Web Site: http://www.ansi.org/home.html

ARINC - Aeronautical Radio Inc.

Aeronautical Radio Inc. (ARINC)
2551 Riva Rd.
Annapolis, MD 21401

Tel: (410) 266-4000
Fax: (410) 266-4040

ASAE - American Society of Agricultural Engineers

2950 Niles Road
St. Joseph, NM 49085-9659

Tel: (616) 429-0300
Fax: (616) 429-3852

ASME - American Society of Mechanical Engineers

American Society of Mechanical Engineers (ASME)
345 E 47th St.
New York, NY 10017

Tel: (212) 705-7722
Fax: (212) 753-9568
World Wide Web Site: http://www.webplus.net/asme

ASNT - American Society for Nondestructive Testing Inc.

American Society for Nondestructive Testing Inc. (ASNT)
1711 Arlingate Lane
PO Box 28518
Columbus, OH 43228-0518

Tel: (614) 274-6003
Fax: (614) 274-6899
World Wide Web Site: http://www.asnt.org/ndt/

ASTM - American Society for Testing Materials

American Society for Testing Materials (ASTM)
1916 Race St.
Philadelphia, PA 19103-1187

Tel: (215) 299-5585
Fax: (215) 977-9679
World Wide Web Site: http://www.astm.org/

ASQC - American Society for Quality Control

American Society for Quality Control (ASQC)
310 W. Wisconsin Ave.
Milwaukee, WI 53202-4606

Tel: (800) 272-1946 *or* (414) 272-8575
Fax: (414) 272-1734
World Wide Web Site: http://www.asqc.org/index.html

ATA - Air Transport Association of America

Air Transport Association of America
PO Box 511
Annapolis Junction, MD 20701

Tel: (202) 626-4000
World Wide Web Site: http://www.air-transport.org/

Bellcore - Bell Communications Research

Information Exchange Management
Bellcore
445 South Street, Room 2J-125
P.O. Box 1910
Morristown, NJ 07962-1910

Telephone: (201) 829-4785
World Wide Web Site: http://www.info.bellcore.com/

CED - Civil Engineering Data

United States Army
Corps of Engineers
20 Massachusetts Avenue, NW
Washington, DC 20314-1000

Tel: (202) 761-0011

DoD - Department of Defense

Copies of MIL-STDs, MIL-HDBKs and Specification are available from:

Standardization Documents Order Desk
700 Robbins Avenue, Bldg. 4D
Philadelphia, PA 19111-5094

Tel: (215) 697-2667
World Wide Web Site: http://www.dtic.mil/dps-phila/dodiss/

EIA/JEDEC - Electronic Industries Association/Joint Electron Device Engineering Council

Electronic Industries Association
2500 Wilson Blvd.
Arlington, VA 22201

Tel: (800) 854-7179
World Wide Web Site: http://www.eia.org/

(For copies of documents)
c/o Global Engineering
15 Inverness Way East
Englewood, CO 80112-5704

Tel: (800) 854-7179
Fax: (303) 792-2192

EOS/ESD Association - Electrical Overstress/Electrostatic Discharge

EOS/ESD Association
7902 Turin Rd, Ste. 4
Rome, NY 13440-2069

Tel: (315) 339-6937
Fax: (315) 339-6793
World Wide Web Site: http://www.eosesd.org/

IEEE - Institute of Electrical & Electronics Engineers

445 Hoes Lane,
PO Box 1331
Piscataway, NJ 08855-1331

Telephone:	(800) 678-IEEE
Outside the US & Canada	(908) 981-1393
Fax:	(908) 981-9667

World Wide Web Site: http://www.ieee.org/

IES - Institute of Environmental Sciences

Institute of Environmental Sciences (IES)
940 East Northwest Highway
Mount Prospect, IL 60056

Tel: (847) 255-1561
Fax: (847) 255-1699

IPC - Institute for Interconnecting and Packaging Electronic Circuits

7380 N. Lincoln Ave.
Lincolnwood, IL 60646-1705
Tel: (708) 677-2850
Fax: (708) 677-9570
World Wide Web Site: http://www.ipc.org/

NASA - National Aeronautics and Space Administration

NASA Center for Aerospace Information
800 Elkridge Landing Rd.
Linthicum Heights, MD 21090-2934

Tel: (301) 621-0134
Fax: (301) 621-0100
World Wide Web Site: http://www.nasa.gov/

NIST - National Institute of Standards and Technology

National Institute of Standards and Technology (NIST)
Gaithersburg, MD 20899

Tel: (301) 975-2000
World Wide Web Site: http://www.nist.gov/

SAE - Society of Automotive Engineers International

400 Commonwealth Drive
Warrendale, PA 15096-0001

Tel: (412) 776-4841
Fax: (412) 776-5760

SEMI - Semiconductor Equipment and Materials International

Semiconductor Equipment and Materials International (SEMI)
805 E. Middlefield Rd.
Mountain View, CA 94043-4080

Tel: (415) 964-5111
Fax: (415) 967-5375
World Wide Web Site: http://www.semi.org/

APPENDIX B: STANDARDS ORGANIZATIONS OUTSIDE THE UNITED STATES

AENOR - Asociación Española de Normalización y Certificación
Spanish Association for Standardization

The Spanish Association for Standardization (AENOR)
Fernández de la Hoz, 52
E-28010 Madrid, Spain

Tel: +(34) 1 432 60 00
Fax: +(34) 1 310 49-76

AFNOR - Association Française de Normalisation
French Association for Normalization

Association Française de Normalisation (AFNOR)
Tour Europe,
F-92049 Paris-La Défense, Cedex, France

Tel: +(33) (1) 42 91 55 55
Fax: +(33) (1) 42 91 56 56

BSI - British Standards Institution

British Standards Institution (BSI)
Customer Information
Linford Wood
Milton Keynes, United Kingdom MK14 6LE

Tel: +(44) 190 822 1166
Fax: +(44) 190 832 0856

CAA - Civil Aviation Authority (UK)

Civil Aviation Authority (CAA)
Aviation House, Room 517
129 Kingsway
London, United Kingdom WC2B 6NN

Tel: +(44) 171 379 7311

CCITT - International Telegraph and Telephone Consultative Committee

International Telecommunication Union (ITU)
Place des Nations
CH-1211 Geneva 20, Switzerland

Tel: +(41) 22 730 5111
Fax: +(41) 22 733 7256
World Wide Web Site: http://www.itu.ch

CNS - Chinese National Standards

Hsin Hai Rd.
Taipei, Taiwan 10637

Tel:
Fax: (886) (2) 735-2656

CSA - Canadian Standards Association

178 Rexdale Boulevard
Rexdale Toronto
Ontario M9W 1R3, Canada

Tel: (416) 747-4000
Fax: (416) 747-4149
World Wide Web Site: http://www.csa.ca/

CEN - European Committee for Standardization

European Committee for Standardization, Central Secretariat
Rue de Stassart, 36
B-1050 Brussels, Belgium

Tel: +(32) 2 519 68 11
Fax: +(32) 2 519 68 19
World Wide Web Site: http://tobbi.iti.is/cen/welcome.html

CENELEC - European Committee for Electrotechnical Standardization

CENELEC
Central Secretariat
Rue de Strassart, 35
B-1050 Brussels, Belgium

Tel: +(32) 2 519 68 71
Fax: +(32) 2 519 69 19

CECC - CENELEC Electronic Components Committee

CENELEC Electronic Components Committee
General Secretary
Gartenstrasse 179, W-6000
Frankfort am Main 70, Germany

CEPT - Conférence Européenne Des Administrations Des Postes Et Des Télécommunications (In English: European Conference of Post and Telecommunications Administrations)

CEPT
Case Postale 1283
CH-3001 Berne, Switzerland

Tel: +(41) 31 622 080
Fax: +(41) 31 622 078

DIN - Deutsches Institut für Normung
German Institute for Standardization

Deutsches Institut für Normung (DIN)
Burggrafenstraße 6
Postfach 11 07
D-1000 Berlin 30, Germany

Tel: +(49) 030 2601-0
Fax: +(49) 030 2601-231

DS - Dansk Standard
Danish Standards Association

Danish Standards Association (DS)
Baunegårdsvej 73
DK-2900 Hellerup, Denmark

Tel: +(45) 39 77 01 01
Fax: +(45) 39 77 02 02

ELOT - Hellenic Organization for Standardization

Hellenic Organization for Standardization (ELOT)
313 Acharnon St.
GR-111 45 Athens, Greece

Tel: +(30) 1 201 5025
Fax: +(30) 1 202 0776

ETSI - European Telecommunications Standards Institute

European Telecommunication Standards Institute (ETSI)
BP 152
F-06561 Valbonne Cedex, France

Tel: +(33) 92 94 42 00
Fax: +(33) 93 65 47 16
World Wide Web Site: http://www.etsi.fr/

IBN - Institute Belge de Normalisation
Belgian Standards Institute

Belgian Standards Institute (IBN)
Avenue de la Brabançonne 29
B-1040 Brussels, Belgium

IEC - International Electrotechnical Committee
World Wide Web Site: http://www.iec.ch/

In Canada IEC documents may be ordered from:

Standards Council of Canada
Standards Sales Division
350 Sparks St. Suite 1200
Ottawa, Ontario K1P 6N7

Tel: (613) 238-3222
Fax: (613) 995-4564

IEC documents may also be purchased (priced in Swiss Francs) directly from:

Sales Dept.
IEC Central Office
PO Box No. 131
3 rue de Varembé
1211 Geneva 20 Switzerland

Tel: +41 22 919 02 11
Fax: +41 22 919 03 00
EMail: dn@iec.ch

ISO - International Organization for Standardization

International Organization for Standardization (ISO)
1, Rue de Varembé
CH-1211 Geneva 20, Switzerland

Tel: +(41) 22 749 0111
Fax: +(41) 22 733 3430
World Wide Web Site: http://www.iso.ch/

ITU - International Telecommunication Union

International Telecommunication Union (ITU)
Place des Nations
CH-1211 Geneva 20, Switzerland

Tel: +(41) 22 730 5111
Fax: +(41) 22 733 7256
World Wide Web Site: http://www2.itu.ch/

JISC - Japanese Industrial Standards Committee

JISC Agency of Industrial Science and Technology
1-3-1 Kasmingaseki, Chiyoda-ku
Tokyo 100, Japan

Tel: +(81) 3 35 01 92 95
Fax: +(81) 3 35 80 14 18

JSA - Japanese Standards Association

Japanese Standards Association
Tatsu Sawada, Public Relations
4-1-24, Akasaka, Mitato-ku
Tokyo, 107 Japan

Fax: +(81) 33 583 80 03 *or* +(81) 33 586 20 29

MOD - Ministry of Defence (UK)
British Defence Standards

Ministry of Defence (MOD)
Kentigern House
65 Brown Street
Glasgow, United Kingdom, G2 8EX

Tel: +(44) 141 218 9000
World Wide Web Site: http://www.mod.uk/

NATO - North Atlantic Treaty Organization

North Atlantic Treaty Organization (NATO)
Ministry of Defence
Kentigern House
65 Brown Street
Glasgow, United Kingdom G2 8EX

Tel: +(41) 248 7890
World Wide Web Site: http://www.nato.int/

NBS - (Chinese) National Bureau of Standards

National Bureau of Standards (NBS)
Ministry of Economic Affairs
3rd. Floor, 185 Hsin-Hai Road Sec. 2
Taipei, Taiwan 10637, Republic of China

Fax: +(886) 2 735 2656

NNI - Netherlands Normalisatie-instituut
Netherlands Standards Institute

Netherlands Standards Institute (NNI)
Kalfjeslaan 2
PO Box 5059
NL-2600 GB Delft, The Netherlands

Tel: +(31) 15 690 390
Fax: +(31) 15 690 190
World Wide Web Site: http://www.nni.nl/

NSAI - National Standards Authority of Ireland

National Standards Authority of Ireland (NSAI)
Eolas
Glasnevin, Dublin 9, Ireland

Tel: +(353) 1 370101
Fax: +(353) 1 369821

NSF - Norges Standardiseringsforbund
Norwegian Standards Association

Norwegian Standards Association (NSF)
PO Box 7020 Homansbyen
N-0306 Oslo 3, Norway

Tel: +(47) 2 46 60 94
Fax: +(47) 2 46 44 57

ON - Osterreichisches Normungsinstitut
Austrian Standards Institute

Austrian Standards Institute (ON)
Heinestrasse 38
Postfach 130
A-1021 Wien, Austria

Tel: +(43) 222 26 75 35
Fax: +(43) 222 26 75 52

SFS - Finish Standards Association

Finish Standards Association (SFS)
PO Box 205
SF-00121 Helsinki 12, Finland

Tel: +(358) 0 645 601
Fax: +(358) 0 643 147
World Wide Web Site: http://www.sfs.fi

SIS - Standardiseringskommissionen i Sverige
Swedish Standards Institution

Swedish Standards Institution (SIS)
PO Box 3295
S-103 66 Stockholm, Sweden

SNV - Schweizerische Normem-Vereninigung
Swiss Association for Standardization

Swiss Association for Standardization (SNV)
Postfach
CH-8032 Zürich, Switzerland

Tel: +(41) 1 384 47 47
Fax: +(41) 1 384 47 74

Standards Association of Australia (Standards Australia)

Standards Association of Australia Headquarters
1 The Crescent
Homebush 2140
POB 1055
Strathfield, NSW 2135, Australia

Tel: +(61) 2 746 4700
Fax: +(61) 2 746 8450
World Wide Web Site: http://www.standards.com.au/~sicsaa

UNI - Ente Nazionale Italiano di Unificazione
Italian National Standards Body

The Italian National Standards Body (UNI)
Via Battistotti Sassi 11
I-20100 Milano, Italy

Tel: +(39) 2 70 02 41
World Wide Web Site: http://www.unicei.it/

VDE - Verband Deutscher Elektrotechniker E.V.
Association of German Electrical Engineers

Verband Deutscher Elektrotechniker E.V. (VDE)
Stresemannallee 15
D-60596 Frankfurt, Germany

Tel: +(49) 69 6308 0
Fax: +(49) 69 6312 925
World Wide Web Site: http://www.vde.de/

VDI - Verein Deutscher Ingenieure
Association of German Engineers

Verein Deutscher Ingenieure (VDI)
Graf-Recke-Str. 84
D-20239 Dusseldorf, Germany

Tel: +(49) 211 6214 0
Fax: +(49) 211 6214 575
World Wide Web Site: http://www.csl-gmbh.net/csl/links/vdi/

APPENDIX C: SUMMARY OF DEPENDABILITY-RELATED STANDARDS

This appendix contains a summary listing of dependability-related standards identified during this effort but were not reviewed due to one or more of the following reasons:

- No English language translation available
- Too industry specific
- Not oriented to system level

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Organization Abbreviation: AFNOR Document #: UTE C 20-310 Date: 1981-12-00
Organization: FRANCE AFNOR ASSOCIATION FRANCAISE DE NORMALISATION
Title (original language): LISTE DES TERMES DE BASE,DEFINITIONS ET MATHEMATIQUES APPLICABLES A LA FIABILITE.
Title (English): LIST OF BASIC TERMS, DEFINITIONS AND RELATED MATHEMATICS FOR RELIABILITY.

Organization Abbreviation: AFNOR Document #: UTE C 20-313 Date: 1981-12-00
Organization: FRANCE AFNOR ASSOCIATION FRANCAISE DE NORMALISATION
Title (original language): GUIDE POUR L'ACQUISITION DES DONNEES DE FIABILITE,DE DISPONIBILITE ET DE MAINTENABILITE A PARTIR DES RESULTATS D'EXPLOITATION DES DISPOSITIFS ELECTRONIQUES.
Title (English): GUIDE FOR THE COLLECTION OF RELIABILITY,AVAILABILITY AND MAINTAINABILITY DATA FROM FIELD PERFORMANCE OF ELECTRONIC ITEMS.

Organization Abbreviation: AFNOR Document #: UTE C 20-315 Date: 1981-12-00
Organization: FRANCE AFNOR ASSOCIATION FRANCAISE DE NORMALISATION
Title (original language): PRESENTATION DES DONNEES DE FIABILITE POUR LES COMPOSANTS (OU PIECES DETACHEES) ELECTRONIQUES.
Title (English): PRESENTATION OF RELIABILITY DATA ON ELECTRONIC COMPONENTS (OR PARTS).

Organization Abbreviation: AFNOR Document #: UTE C 20-316 Date: 1982-06-00
Organization: FRANCE AFNOR ASSOCIATION FRANCAISE DE NORMALISATION
Title (original language): GUIDE POUR L'INCLUSION DE CLAUSES DE FIABILITE DANS LES SPECIFICATIONS DE COMPOSANTS (OU PIECES DETACHEES) POUR L'EQUIPEMENT ELECTRONIQUE.
Title (English): GUIDE FOR THE INCLUSION OF RELIABILITY CLAUSES INTO SPECIFICATIONS FOR COMPONENTS (OR PARTS) FOR ELECTRONIC EQUIPMENT.

Organization Abbreviation: AFNOR Document #: UTE C 20-317 Date: 1990-05-00
Organization: FRANCE AFNOR ASSOCIATION FRANCAISE DE NORMALISATION
Title (original language): PROGRAMMES DE CROISSANCE DE FIABILITE.
Title (English): PROGRAMMES FOR RELIABILITY GROWTH.

Organization Abbreviation: AFNOR Document #: UTE C 20-318 Date: 1990-12-00
Organization: FRANCE AFNOR ASSOCIATION FRANCAISE DE NORMALISATION
Title (original language): ANALYSE PAR ARBRE DE PANNE (AAP).
Title (English): FAULT TREE ANALYSIS (FTA).

Organization Abbreviation: AFNOR Document #: UTE C 20-321 Date: 1981-12-00
Organization: FRANCE AFNOR ASSOCIATION FRANCAISE DE NORMALISATION
Title (original language): ESSAI DE FIABILITE DES EQUIPEMENTS. PREMIERE PARTIE : PRESCRIPTIONS GENERALES.
Title (English): EQUIPMENT RELIABILITY TESTING. PART 1 : GENERAL REQUIREMENTS.

Organization Abbreviation: AFNOR Document #: UTE C 20-323-1 Date: 1987-03-00
Organization: FRANCE AFNOR ASSOCIATION FRANCAISE DE NORMALISATION
Title (original language): ESSAI DE FIABILITE DES EQUIPEMENTS. TROISIEME PARTIE : CONDITIONS D'ESSAI PREFERENTIELLES. EQUIPEMENTS PORTATIFS D'INTERIEUR. FAIBLE DEGRE DE SIMULATION.
Title (English): EQUIPMENT RELIABILITY TESTING. PART 3 : PREFERRED TEST CONDITIONS. INDOOR PORTABLE EQUIPMENT. LOW DEGREE OF SIMULATION.

Organization Abbreviation: AFNOR Document #: UTE C 20-323-2 Date: 1987-03-00
Organization: FRANCE AFNOR ASSOCIATION FRANCAISE DE NORMALISATION
Title (original language): ESSAI DE FIABILITE DES EQUIPEMENTS. TROISIEME PARTIE : CONDITIONS D'ESSAI PREFERENTIELLES. EQUIPEMENTS POUR UTILISATION A POSTE FIXE A L'ABRI DES INTEMPERIES. DEGRE DE SIMULATION ELEVE.
Title (English): EQUIPMENT RELIABILITY TESTING. PART 3 : PREFERRED TEST CONDITIONS. EQUIPMENT FOR STATIONARY USE IN WEATHERPROTECTED LOCATIONS. HIGH DEGREE OF SIMULATION.

Organization Abbreviation: AFNOR Document #: UTE C 20-323-3 Date: 1993-02-00
Organization: FRANCE AFNOR ASSOCIATION FRANCAISE DE NORMALISATION
Title (original language): ESSAI DE FIABILITE DES EQUIPEMENTS. TROISIEME PARTIE : CONDITIONS D'ESSAI PREFERENTIELLES. EQUIPEMENTS POUR UTILISATION A POSTE FIXE PARTIELLEMENT A L'ABRI DES INTEMPERIES FAIBLE DEGRE DE SIMULATION.
Title (English): EQUIPMENT RELIABILITY TESTING. PART 3 : PREFERRED TEST CONDITIONS. EQUIPMENT FOR STATIONARY USE IN PARTIALLY WEATHERPROTECTED LOCATIONS LOW DEGREE OF SIMULATION.

Organization Abbreviation: AFNOR Document #: UTE C 20-323-4 Date: 1992-10-00
Organization: FRANCE AFNOR ASSOCIATION FRANCAISE DE NORMALISATION
Title (original language): ESSAI DE FIABILITE DES EQUIPEMENTS. TROSIEME PARTIE : CONDITIONS D'ESSAI PREFERENTIELLES. EQUIPEMENTS PORTATIFS A UTILISATION EN DEPLACEMENT. FAIBLE DEGRE DE SIMULATION.
Title (English): EQUIPMENT RELIABILITY TESTING. PART 3 : PREFERED TEST CONDITIONS. EQUIPMENT FOR PORTABLE AND NON-STATIONARY USE. LOW DEGREE OF SIMULATION.

Organization Abbreviation: AFNOR Document #: UTE C 20-324 Date: 1987-01-00
Organization: FRANCE AFNOR ASSOCIATION FRANCAISE DE NORMALISATION
Title (original language): ESSAI DE FIABILITE DES EQUIPEMENTS. QUATRIEME PARTIE : METHODE DE CALCUL DES ESTIMATEURS PONCTUELS ET DES LIMITES DE CONFIANCE RESULTANT D'ESSAIS DE DETERMINATION DE LA FIABILITE D'EQUIPEMENTS.
Title (English): EQUIPMENT RELIABILITY TESTING. PART 4 : PROCEDURES FOR DETERMINING POINT ESTIMATES AND CONFIDENCE LIMITS FROM EQUIPMENT RELIABILITY DETERMINATION TESTS.

Organization Abbreviation: AFNOR Document #: UTE C 20-325 Date: 1985-08-00
Organization: FRANCE AFNOR ASSOCIATION FRANCAISE DE NORMALISATION
Title (original language): ESSAI DE FIABILITE DES EQUIPEMENTS. CINQUIEME PARTIE : PLANS D'ESSAI DE CONFORMITE POUR UNE PROPORTION DE SUCCES.
Title (English): EQUIPMENT RELIABILITY TESTING. PART 5 : COMPLIANCE TEST PLANS FOR SUCCESS RATIO.

Organization Abbreviation: AFNOR Document #: UTE C 20-326 Date: 1987-08-00
Organization: FRANCE AFNOR ASSOCIATION FRANCAISE DE NORMALISATION
Title (original language): ESSAI DE FIABILITE DES EQUIPEMENTS. SIXIEME PARTIE : TESTS DE VALIDITE DE L'HYPOTHESE D'UN TAUX DE DEFAILLANCE CONSTANT.
Title (English): EQUIPMENT RELIABILITY TESTING. PART 6 : TESTS FOR THE VALIDITY OF A CONSTANT FAILURE RATE ASSUMPTION.

Organization Abbreviation: AFNOR Document #: UTE C 20-327 Date: 1981-12-00
Organization: FRANCE AFNOR ASSOCIATION FRANCAISE DE NORMALISATION
Title (original language): ESSAI DE FIABILITE DES EQUIPEMENTS. SEPTIEME PARTIE : PLANS D'ECHANTILLONNAGE POUR CONFIRMER LE TAUX DE DEFAILLANCE ET LA MOYENNE DES TEMPS DE BON FONCTIONNEMENT DANS L'HYPOTHESE D'UN TAUX DE DEFAILLANCE CONSTANT.
Title (English): EQUIPMENT RELIABILITY TESTING. PART 7 : COMPLIANCE TEST PLANS FOR FAILURE RATE AND MEAN TIME BETWEEN FAILURES-ASSUMING CONSTANT FAILURE RATE.

Organization Abbreviation: AFNOR Document #: UTE C 20-340 Date: 1992-10-00
Organization: FRANCE AFNOR ASSOCIATION FRANCAISE DE NORMALISATION
Title (original language): SURETE DE FONCTIONNEMENT. PROCEDURES D'ESSAI DE CONFORMITE POUR LA DISPONIBILITE EN REGIME ETABLI.
Title (English): DEPENDABILITY. COMPLIANCE TEST PROCEDURES FOR STEADY-STATE AVAILABILITY.

Organization Abbreviation: AFNOR Document #: NFC 20-341, NFEN 61 078 Date: 1994-10-00
Organization: FRANCE AFNOR ASSOCIATION FRANCAISE DE NORMALISATION
Title (original language): TECHNIQUES D'ANALYSE DE LA SURETE DE FONCTIONNEMENT. METHODE DU DIAGRAMME DE FIABILITE. (NORME EUROPEENNE EN 61 078).
Title (English): ANALYSIS TECHNIQUES FOR DEPENDABILITY. RELIABILITY BLOCK DIAGRAM METHOD. (EUROPEAN STANDARD EN 61 078).

Organization Abbreviation: AFNOR Document #: NFE 22-394 Date: 1986-11-00
Organization: FRANCE AFNOR ASSOCIATION FRANCAISE DE NORMALISATION
Title (original language): ROULEMENTS. FIABILITE DES ENSEMBLES DE ROULEMENTS.
Title (English): ROLLING BEARINGS. SYSTEM RELIABILITY.

Organization Abbreviation: AFNOR Document #: NFE 44-153 Date: 1993-05-00
Organization: FRANCE AFNOR ASSOCIATION FRANCAISE DE NORMALISATION
Title (original language): POMPES ROTODYNAMIQUES. SPECIFICATIONS TECHNIQUES POUR POMPES ROTODYNAMIQUES POUR L'EAU. CLASSE I (DEGRE DE FIABILITE ELEVE).
Title (English): ROTODYNAMIC PUMPS. TECHNICAL SPECIFICATIONS FOR ROTODYNAMIC PUMPS FOR WATER. CLASS I (HIGH DEGREE OF RELIABILITY).

Organization Abbreviation: AFNOR Document #: NFF 01-305 Date: 1989-12-00
Organization: FRANCE AFNOR ASSOCIATION FRANCAISE DE NORMALISATION
Title (original language): MATERIEL ROULANT FERROVIAIRE. FIABILITE,NOTIONS DE MAINTENABILITE ET DE DISPONIBILITE.
Title (English): RAILWAY ROLLING STOCK. RELIABILITY,AND FIRST STEPS IN MAINTAINABILITY AND AVAILABILITY.

Organization Abbreviation: AFNOR Document #: NFF 67-001-6 Date: 1992-12-00
Organization: FRANCE AFNOR ASSOCIATION FRANCAISE DE NORMALISATION
Title (original language): MATERIEL ROULANT FERROVIAIRE. EQUIPEMENTS ELECTRONIQUES ET MICRO-INFORMATIQUES EMBARQUES. SIXIEME PARTIE : FIABILITE. MAINTENABILITE. DISPONIBILITE. TESTABILITE.
Title (English): RAILWAY ROLLING STOCK. INBORNE ELECTRONIC AND MICROPROCESSOR EQUIPMENT. PART 6 : RELIABILITY. MAINTAINABILITY. AVAILABILITY. TESTABILITY.

Organization Abbreviation: AFNOR Document #: L 00-005-08 Date: 1988-11-00
Organization: FRANCE AFNOR ASSOCIATION FRANCAISE DE NORMALISATION
Title (original language): AERONAUTIQUE ET ESPACE. LISTE DE TERMES EQUIVALENTS. PARTIE 8 : FIABILITE DES AERONEFS.
Title (English): AEROSPACE. LIST OF EQUIVALENT TERMS. PART 8 : AIRCRAFT RELIABILITY.

Organization Abbreviation: AFNOR Document #: P 06-007 Date: 1988-09-00
Organization: FRANCE AFNOR ASSOCIATION FRANCAISE DE NORMALISATION
Title (original language): PRINCIPES GENERAUX DE LA FIABILITE DES CONSTRUCTIONS. LISTE DE TERMES EQUIVALENTS.
Title (English): GENERAL PRINCIPLES ON RELIABILITY OF STRUCTURES. LIST OF EQUIVALENT TERMS.

Organization Abbreviation: AFNOR Document #: NFX 06-006 Date: 1972-04-00
Organization: FRANCE AFNOR ASSOCIATION FRANCAISE DE NORMALISATION
Title (original language): APPLICATIONS DE LA STATISTIQUE. SYMBOLES DU CALCUL DES PROBABILITES,DE LA STATISTIQUE,DU CONTROLE DE LA QUALITE ET DE LA FIABILITE.
Title (English): APPLICATIONS OF STATISTICS. SYMBOLS OF THE THEORY OF PROBABILITIES,STATISTICS,QUALITY CONTROL AND RELIABILITY.

Organization Abbreviation: AFNOR Document #: X 06-501 Date: 1984-09-00
Organization: FRANCE AFNOR ASSOCIATION FRANCAISE DE NORMALISATION
Title (original language): APPLICATIONS DE LA STATISTIQUE. INTRODUCTION A LA FIABILITE.
Title (English): APPLICATION OF STATISTICS. INITIATION INTO RELIABILITY.

Organization Abbreviation: AFNOR Document #: X 60-301 Date: 1982-05-00
Organization: FRANCE AFNOR ASSOCIATION FRANCAISE DE NORMALISATION
Title (original language): GUIDE POUR LA PRISE EN COMPTE DES CRITERES DE MAINTENABILITE DES BIENS DURABLES A USAGE INDUSTRIEL ET PROFESSIONNEL.
Title (English): GUIDE FOR TAKING INTO ACCOUNT CRITERIA FOR MAINTAINABILITY OF DURABLES FOR INDUSTRIAL AND PROFESSIONAL USE.

Organization Abbreviation: AFNOR Document #: X 60-310 Date: 1986-11-00
Organization: FRANCE AFNOR ASSOCIATION FRANCAISE DE NORMALISATION
Title (original language): GUIDE DE MAINTENABILITE DE MATERIEL. PREMIERE PARTIE : SECTIONS UN,DEUX ET TROIS. INTRODUCTION,EXIGENCES ET PROGRAMME DE MAINTENABILITE.
Title (English): GUIDE ON MAINTAINABILITY OF EQUIPMENT. PART 1 : SECTIONS ONE,TWO AND THREE. INTRODUCTION,REQUIREMENTS AND MAINTAINABILITY PROGRAMME.

Organization Abbreviation: AFNOR Document #: X 60-311 Date: 1991-02-00
Organization: FRANCE AFNOR ASSOCIATION FRANCAISE DE NORMALISATION
Title (original language): GUIDE DE MAINTENABILITE DE MATERIEL. DEUXIEME PARTIE : SECTION CINQ. ETUDES DE MAINTENABILITE AU NIVEAU DE LA CONCEPTION.
Title (English): GUIDE ON MAINTAINABILITY OF EQUIPMENT. PART TWO : SECTION FIVE. MAINTAINABILITY STUDIES DURING THE DESIGN PHASE.

Organization Abbreviation: AFNOR Document #: X 60-312 Date: 1988-05-00
Organization: FRANCE AFNOR ASSOCIATION FRANCAISE DE NORMALISATION
Title (original language): GUIDE DE MAINTENABILITE DE MATERIEL. TROISIEME PARTIE : SECTIONS SIX ET SEPT. VERIFICATION ET RECUEIL, ANALYSE ET PRESENTATION DES DONNEES.
Title (English): GUIDE ON MAINTAINABILITY OF EQUIPMENT. PART 3 : SECTIONS SIX AND SEVEN - VERIFICATION AND COLLECTION,ANALYSIS AND PRESENTATION OF DATA.

Organization Abbreviation: AFNOR Document #: X 60-500 Date: 1988-10-00
Organization: FRANCE AFNOR ASSOCIATION FRANCAISE DE NORMALISATION
Title (original language): TERMINOLOGIE RELATIVE A LA FIABILITE. MAINTENABILITE. DISPONIBILITE.
Title (English): TERMINOLOGY RELATING TO RELIABILITY, MAINTAINABILITY AND AVAILABILITY.

Organization Abbreviation: AFNOR Document #: X 60-502 Date: 1986-12-00
Organization: FRANCE AFNOR ASSOCIATION FRANCAISE DE NORMALISATION
Title (original language): FIABILITE EN EXPLOITATION ET APRES-VENTE.
Title (English): OPERATING RELIABILITY AND AFTER-SALES-SERVICE.

Organization Abbreviation: AFNOR Document #: X 60-503 Date: 1985-11-00
Organization: FRANCE AFNOR ASSOCIATION FRANCAISE DE NORMALISATION
Title (original language): INTRODUCTION A LA DISPONIBILITE.
Title (English): INITIATION INTO AVAILABILITY.

Organization Abbreviation: AFNOR Document #: X 60-510 Date: 1986-12-00
Organization: FRANCE AFNOR ASSOCIATION FRANCAISE DE NORMALISATION
Title (original language): TECHNIQUES D'ANALYSE DE LA FIABILITE DES SYSTEMES. PROCEDURE D'ANALYSE DES MODES DE DEFAILLANCE ET DE LEURS EFFETS (AMDE).
Title (English): ANALYSIS TECHNIQUES FOR SYSTEM RELIABILITY. PROCEDURE FOR FAILURE MODE AND EFFECTS ANALYSIS (FMEA).

Organization Abbreviation: AFNOR Document #: X 60-520 Date: 1988-05-00
Organization: FRANCE AFNOR ASSOCIATION FRANCAISE DE NORMALISATION
Title (original language): PREVISIONS DES CARACTERISTIQUES DE FIABILITE,MAINTENABILITE ET DISPONIBILITE.
Title (English): PRESENTATION OF RELIABILITY, MAINTAINABILITY AND AVAILABILITY PREDICTIONS.

Organization Abbreviation: AIA/NAS Document #: NAS 1717 Date: 1967-00-00
Organization: AIA/NAS AEROSPACE INDUSTRIES ASSOCIATION OF AMERICA INC (AIA/NAS)
Title (original language):
Title (English): RELIABILITY DEMONSTRATION OF LIQUID PROPELLANT ROCKET ENGINES

Organization Abbreviation: AIA/NAS Document #: NAS 1718 Date: 1967-00-00
Organization: AIA/NAS AEROSPACE INDUSTRIES ASSOCIATION OF AMERICA INC (AIA/NAS)
Title (original language):
Title (English): RELIABILITY DEMONSTRATION OF SOLID PROPELLANT ROCKET MOTORS

Organization Abbreviation: ANSI/IEEE Document #: 352 Date: 1987-00-00
Organization: ANSI/IEEE AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)
Title (original language):
Title (English): GUIDE FOR GENERAL PRINCIPLES OF RELIABILITY ANALYSIS OF NUCLEAR POWER GENERATING STATION SAFETY SYSTEMS (R 1994)

Organization Abbreviation: ANSI/SAE Document #: J 1032 Date: 1987-00-00
Organization: ANSI/SAE AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)
Title (original language):
Title (English): DEFINITIONS FOR MACHINE AVAILABILITY (OFF-ROAD WORK MACHINES), RECOMMENDED PRACTICE; APRIL 1987

Organization Abbreviation: ARINC Document #: 628 ITEM 12.0 Date:
Organization: ARINC AERONAUTICAL RADIO INC (ARINC)
Title (original language):
Title (English): RELIABILITY

Organization Abbreviation: ARINC Document #: 651 Date: 1991-00-00
Organization: ARINC AERONAUTICAL RADIO INC (ARINC)
Title (original language):
Title (English): DESIGN GUIDANCE FOR INTEGRATED MODULAR AVIONICS

Organization Abbreviation: ARINC Document #: 651 ITEM 1.0 Date:
Organization: ARINC AERONAUTICAL RADIO INC (ARINC)
Title (original language):
Title (English): INTRODUCTION

Organization Abbreviation: ARINC Document #: 651 ITEM 2.0 Date:
Organization: ARINC AERONAUTICAL RADIO INC (ARINC)
Title (original language):
Title (English): OBJECTIVES

Organization Abbreviation: ARINC Document #: 651 ITEM 9.0 Date:
Organization: ARINC AERONAUTICAL RADIO INC (ARINC)
Title (original language):
Title (English): TESTABILITY AND MAINTAINABILITY

Organization Abbreviation: ARINC Document #: 651 ATT Date:
Organization: ARINC AERONAUTICAL RADIO INC (ARINC)
Title (original language):
Title (English): ATTACHMENT

Organization Abbreviation: ARINC Document #: 651 APP Date:
Organization: ARINC AERONAUTICAL RADIO INC (ARINC)
Title (original language):
Title (English): APPENDIX

Organization Abbreviation: ASAE Document #: EP456 Date: 1987-00-00
Organization: ASAE AMERICAN SOCIETY OF AGRICULTURAL ENGINEERS (ASAE)
Title (original language):
Title (English): TEST AND RELIABILITY GUIDELINES (R 1991)

Organization Abbreviation: ASNT Document #: 2021 Date: 1982-00-00
Organization: ASNT AMERICAN SOCIETY FOR NONDESTRUCTIVE TESTING INC (ASNT)
Title (original language):
Title (English): RECOMMENDED PRACTICE FOR A DEMONSTRATION OF NONDESTRUCTIVE EVALUATION (NDE) RELIABILITY ON AIRCRAFT PRODUCTION PARTS (INCLUDES APPENDIX A, B AND C)

Organization Abbreviation: ASTM Document #: E1246 Date: 1988-00-00
Organization: ASTM AMERICAN SOCIETY FOR TESTING & MATERIALS (ASTM)
Title (original language):
Title (English): STANDARD PRACTICE FOR REPORTING RELIABILITY OF CLINICAL LABORATORY COMPUTER SYSTEMS

Organization Abbreviation: BSI Document #: BS 6548: PART 6 Date: 1995-00-00
Organization: BSI BRITISH STANDARDS INSTITUTION (BSI)
Title (original language):
Title (English): 1995 MAINTAINABILITY OF EQUIPMENT PART 6: GUIDE TO STATISTICAL METHODS IN MAINTAINABILITY EVALUATION (IEC 706-6: 1994) (F)

Organization Abbreviation: BSI Document #: BS 6913: PART 7 Date: 1991-00-00
Organization: BSI BRITISH STANDARDS INSTITUTION (BSI)
Title (original language):
Title (English): 1991 OPERATION AND MAINTENANCE OF EARTH-MOVING MACHINERY PART 7: GLOSSARY FOR MACHINE AVAILABILITY (ISO 8927: 1991)

Organization Abbreviation: BSI Document #: BS EN 61078 Date: 1994-00-00
Organization: BSI BRITISH STANDARDS INSTITUTION (BSI)
Title (original language):
Title (English):1994 AMD 1 RELIABILITY OF SYSTEMS, EQUIPMENT AND COMPONENTS PART 9: GUIDE TO THE BLOCK DIAGRAM TECHNIQUE (AMD 8152) APRIL 15, 1994 (IEC 1078: 1991) (G)

Organization Abbreviation: BSI Document #: BS ISO 2382/XIV Date: 1978-00-00
Organization: BSI BRITISH STANDARDS INSTITUTION (BSI)
Title (original language):
Title (English): 1978 INFORMATION TECHNOLOGY - VOCABULARY PART 14: RELIABILITY, MAINTENANCE AND AVAILABILITY

Organization Abbreviation: BSI Document #: HANDBOOK NO. 22 PART 2 Date: 1992-00-00
Organization: BSI BRITISH STANDARDS INSTITUTION (BSI)
Title (original language):
Title (English): 1992 RELIABILITY AND MAINTAINABILITY (G)

Organization Abbreviation: BSI Document #: DD 57 Date: 1978-00-00
Organization: BSI BRITISH STANDARDS INSTITUTION (BSI)
Title (original language):
Title (English): 1978 DEVELOPMENT OF METHODS OF EQUIPMENT RELIABILITY TESTING

Organization Abbreviation: CAA — Document #: CHAPTER J2-1APP#3 09.66 — Date:

Organization: CAA CIVIL AVIATION AUTHORITY (CAA)
Title (original language):
Title (English): SYSTEM RELIABILITY

Organization Abbreviation: CAA — Document #: CHAPTER B7-1APP08.83 — Date:

Organization: CAA CIVIL AVIATION AUTHORITY (CAA)
Title (original language):
Title (English): GENERAL RELIABILITY

Organization Abbreviation: CAA — Document #: CHAP G6-13 APP #1 11.85 — Date:

Organization: CAA CIVIL AVIATION AUTHORITY (CAA)
Title (original language):
Title (English): SYSTEMS RELIABILITY (ROTOCRAFT)

Organization Abbreviation: CAA — Document #: CHAPTER K6-1 2 APP1 10.92 — Date:

Organization: CAA CIVIL AVIATION AUTHORITY (CAA)
Title (original language):
Title (English): SYSTEMS RELIABILITY

Organization Abbreviation: ITU-R — Document #: RECMN 352-4 — Date: 1982-00-00
Organization: ITU-R INTERNATIONAL RADIO CONSULTATIVE COMMITTEE (CCIR)
Title (original language):
Title (English): HYPOTHETICAL REFERENCE CIRCUIT FOR SYSTEMS USING ANALOG TRANSMISSION IN THE FIXED-SATELLITE SERVICE - SECTION 4B2 - PERFORMANCE AND AVAILABILITY

Organization Abbreviation: ITU-R — Document #: RECMN 353-6 — Date: 1990-00-00
Organization: ITU-R INTERNATIONAL RADIO CONSULTATIVE COMMITTEE (CCIR)
Title (original language):
Title (English): ALLOWABLE NOISE POWER IN THE HYPOTHETICAL REFERENCE CIRCUIT FOR FREQUENCY-DIVISION MULTIPLEX TELEPHONY IN THE FIXED-SATELLITE SERVICE - SECTION 4B2 - PERFORMANCE AND AVAILABILITY

Organization Abbreviation: ITU-R — Document #: RECMN 353-7 — Date: 1992-00-00
Organization: ITU-R INTERNATIONAL RADIO CONSULTATIVE COMMITTEE (CCIR)
Title (original language):
Title (English): ALLOWABLE NOISE POWER IN THE HYPOTHETICAL REFERENCE CIRCUIT FOR FREQUENCY-DIVISION MULTIPLEX TELEPHONY IN THE FIXED-SATELLITE SERVICE - SECTION 4B2 - PERFORMANCE AND AVAILABILITY

Organization Abbreviation: ITU-R — Document #: RECMN 354-2 — Date: 1974-00-00
Organization: ITU-R INTERNATIONAL RADIO CONSULTATIVE COMMITTEE (CCIR)
Title (original language):
Title (English): VIDEO BANDWIDTH AND PERMISSIBLE NOISE LEVEL IN THE HYPOTHETICAL REFERENCE CIRCUIT FOR THE FIXED-SATELLITE SERVICE - SECTION 4B2 - PERFORMANCE AND AVAILABILITY

Organization Abbreviation: ITU-R — Document #: RECMN 521-2 — Date: 1986-00-00
Organization: ITU-R INTERNATIONAL RADIO CONSULTATIVE COMMITTEE (CCIR)
Title (original language):
Title (English): HYPOTHETICAL REFERENCE DIGITAL PATH FOR SYSTEMS USING DIGITAL TRANSMISSION IN THE FIXED-SATELLITE SERVICE - SECTION 4B2 - PERFORMANCE AND AVAILABILITY

Organization Abbreviation: ITU-R — Document #: RECMN 522-3 — Date: 1990-00-00
Organization: ITU-R INTERNATIONAL RADIO CONSULTATIVE COMMITTEE (CCIR)
Title (original language):
Title (English): ALLOWABLE BIT ERROR RATIOS AT THE OUTPUT OF THE HYPOTHETICAL REFERENCE DIGITAL PATH FOR SYSTEMS IN THE FIXED-SATELLITE SERVICE USING PULSE-CODE MODULATION FOR TELEPHONY - SECTION 4B2 - PERFORMANCE AND AVAILABILITY

Organization Abbreviation: ITU-R — Document # RECMN 522-4 — Date: 1992-00-00
Organization: ITU-R INTERNATIONAL RADIO CONSULTATIVE COMMITTEE (CCIR)
Title (original language):
Title (English):ALLOWABLE BIT ERROR RATIOS AT THE OUTPUT OF THE HYPOTHETICAL REFERENCE DIGITAL PATH FOR SYSTEMS IN THE FIXED-SATELLITE SERVICE USING PULSE-CODE MODULATION FOR TELEPHONY - SECTION 4B2 - PERFORMANCE AND AVAILABILITY

Organization Abbreviation: ITU-R — Document #: RECMN 579-1 — Date: 1986-00-00
Organization: ITU-R INTERNATIONAL RADIO CONSULTATIVE COMMITTEE (CCIR)
Title (original language):
Title (English): AVAILABILITY OBJECTIVES FOR A HYPOTHETICAL REFERENCE CIRCUIT AND A HYPOTHETICAL REFERENCE DIGITAL PATH WHEN USED FOR TELEPHONY USING PULSE-CODE MODULATION, OR AS PART OF AN INTEGRATED SERVICES DIGITAL NETWORK HYPOTHETICAL REFERENCE CONNECTION, IN THE FIXED-SATELLITE SERVICE - SECTION 4B2 - PERFORMANCE AND AVAILABILITY

Organization Abbreviation: ITU-R — Document #: RECMN 579-2 — Date: 1992-00-00
Organization: ITU-R INTERNATIONAL RADIO CONSULTATIVE COMMITTEE (CCIR)
Title (original language):
Title (English): AVAILABILITY OBJECTIVES FOR A HYPOTHETICAL REFERENCE CIRCUIT AND A HYPOTHETICAL REFERENCE DIGITAL PATH WHEN USED FOR TELEPHONY USING PULSE-CODE MODULATION, OR AS PART OF AN INTEGRATED SERVICES DIGITAL NETWORK HYPOTHETICAL REFERENCE CONNECTION, IN THE FIXED-SATELLITE SERVICE - SECTION 4B2 - PERFORMANCE AND AVAILABILITY

Organization Abbreviation: ITU-R — Document #: RECMN 614-1 — Date: 1990-00-00

Organization: ITU-R INTERNATIONAL RADIO CONSULTATIVE COMMITTEE (CCIR)
Title (original language):
Title (English): ALLOWABLE ERROR PERFORMANCE FOR A HYPOTHETICAL REFERENCE DIGITAL PATH IN THE FIXED-SATELLITE SERVICE OPERATING BELOW 15 GHZ WHEN FORMING PART OF AN INTERNATIONAL CONNECTION IN AN INTEGRATED SERVICES DIGITAL NETWORK - SECTION 4B2 - PERFORMANCE AND AVAILABILITY

Organization Abbreviation: ITU-R Document #: RECMN 614-2 Date: 1992-00-00
Organization: ITU-R INTERNATIONAL RADIO CONSULTATIVE COMMITTEE (CCIR)
Title (original language):
Title (English): ALLOWABLE ERROR PERFORMANCE FOR A HYPOTHETICAL REFERENCE DIGITAL PATH IN THE FIXED-SATELLITE SERVICE OPERATING BELOW 15 GHZ WHEN FORMING PART OF AN INTERNATIONAL CONNECTION IN AN INTEGRATED SERVICES DIGITAL NETWORK - SECTION 4B2 - PERFORMANCE AND AVAILABILITY

Organization Abbreviation: ITU-R Document #: RECMN 730 Date: 1992-00-00
Organization: ITU-R INTERNATIONAL RADIO CONSULTATIVE COMMITTEE (CCIR)
Title (original language):
Title (English): COMPENSATION OF THE EFFECTS OF SWITCHING DISCONTINUITIES FOR VOICE BAND DATA AND OF DOPPLER FREQUENCY-SHIFTS IN THE FIXED-SATELLITE SERVICE - SECTION 4B2 - PERFORMANCE AND AVAILABILITY

Organization Abbreviation: ITU-R Document #: REPORT 208-7 Date: 1990-00-00
Organization: ITU-R INTERNATIONAL RADIO CONSULTATIVE COMMITTEE (CCIR)
Title (original language):
Title (English): FORM OF THE HYPOTHETICAL REFERENCE CIRCUIT AND ALLOWABLE NOISE STANDARDS FOR FREQUENCY- DIVISION MULTIPLEX TELEPHONY AND TELEVISION IN THE FIXED-SATELLITE SERVICE - SECTION 4B2 - PERFORMANCE AND AVAILABILITY

Organization Abbreviation: ITU-R Document #: REPORT 214-4 Date: 1986-00-00
Organization: ITU-R INTERNATIONAL RADIO CONSULTATIVE COMMITTEE (CCIR)
Title (original language):
Title (English): EFFECTS OF DOPPLER FREQUENCY-SHIFTS AND SWITCHING DISCONTINUITIES IN THE FIXED-SATELLITE SERVICE - SECTION 4B2 - PERFORMANCE AND AVAILABILITY

Organization Abbreviation: ITU-R Document #: REPORT 706-2 Date: 1986-00-00
Organization: ITU-R INTERNATIONAL RADIO CONSULTATIVE COMMITTEE (CCIR)
Title (original language):
Title (English): AVAILABILITY OF CIRCUITS IN THE FIXED-SATELLITE SERVICE - SECTION 4B2 - PERFORMANCE AND AVAILABILITY

Organization Abbreviation: ITU-R Document #: REPORT 997-1 Date: 1990-00-00
Organization: ITU-R INTERNATIONAL RADIO CONSULTATIVE COMMITTEE (CCIR)
Title (original language):
Title (English): CHARACTERISTICS OF A FIXED-SATELLITE SERVICE HYPOTHETICAL REFERENCE DIGITAL PATH FORMING PART OF AN INTEGRATED SERVICES DIGITAL NETWORK - SECTION 4B2 - PERFORMANCE AND AVAILABILITY

Organization Abbreviation: ITU-R Document #: RECMN 766 Date: 1992-00-00
Organization: ITU-R INTERNATIONAL RADIO CONSULTATIVE COMMITTEE (CCIR)
Title (original language):
Title (English): METHODS FOR DETERMINING THE EFFECTS OF INTERFERENCE ON THE PERFORMANCE AND THE AVAILABILITY OF TERRESTRIAL RADIO-RELAY SYSTEMS AND SYSTEMS IN THE FIXED-SATELLITE SERVICE SECTION 4/9B - CO-ORDINATION AND INTERFERENCE CALCULATIONS

Organization Abbreviation: ITU-R Document #: REPORT 388-6 Date: 1990-00-00
Organization: ITU-R INTERNATIONAL RADIO CONSULTATIVE COMMITTEE (CCIR)
Title (original language):
Title (English): METHODS FOR DETERMINING THE EFFECTS OF INTERFERENCE ON THE PERFORMANCE AND THE AVAILABILITY OF TERRESTRIAL RADIO-RELAY SYSTEMS AND SYSTEMS IN THE FIXED-SATELLITE SERVICE - SECTION 4/9B - CO-ORDINATION AND INTERFERENCE CALCULATIONS

Organization Abbreviation: ITU-R Document #: REPORT 892-2 Date: 1990-00-00
Organization: ITU-R INTERNATIONAL RADIO CONSULTATIVE COMMITTEE (CCIR)
Title (original language):
Title (English): COMPUTATION OF RELIABILITY FOR HF RADIO SYSTEMS - SECTION 6E - IONOSPHERIC PROPAGATION PREDICTION AT FREQUENCIES BETWEEN ABOUT 1.6 AND 30 MHZ

Organization Abbreviation: ITU-R Document #: RECMN 547 Date: 1978-00-00
Organization: ITU-R INTERNATIONAL RADIO CONSULTATIVE COMMITTEE (CCIR)
Title (original language):
Title (English): NOISE OBJECTIVES IN THE HYPOTHETICAL REFERENCE CIRCUIT FOR SYSTEMS IN THE MARITIME MOBILE-SATELLITE SERVICE - SECTION 8G - AVAILABILITY, PERFORMANCE OBJECTIVES AND INTERWORKING WITH TERRESTRIAL NETWORKS

Organization Abbreviation: ITU-R Document #: RECMN 549-1 Date: 1982-00-00
Organization: ITU-R INTERNATIONAL RADIO CONSULTATIVE COMMITTEE (CCIR)
Title (original language):
Title (English): SIDE TONE REFERENCE EQUIVALENT OF HANDSET USED ON BOARD A SHIP IN THE MARITIME MOBILE-SATELLITE SERVICE AND IN AUTOMATED VHF/UHF MARITIME MOBILE RADIO TELEPHONE SYSTEMS - SECTION 8G - AVAILABILITY, PERFORMANCE OBJECTIVES AND INTERWORKING WITH TERRESTRIAL NETWORKS

Organization Abbreviation: ITU-R Document #: RECMN 552 Date: 1978-00-00
Organization: ITU-R INTERNATIONAL RADIO CONSULTATIVE COMMITTEE (CCIR)
Title (original language):
Title (English): QUALITY OBJECTIVES FOR 50-BAUD START-STOP TELEGRAPH TRANSMISSION IN THE MARITIME MOBILE-SATELLITE SERVICE - SECTION 8G - AVAILABILITY, PERFORMANCE OBJECTIVES AND INTERWORKING WITH TERRESTRIAL NETWORKS

Organization Abbreviation: ITU-R Document #: REPORT 751 Date: 1978-00-00
Organization: ITU-R INTERNATIONAL RADIO CONSULTATIVE COMMITTEE (CCIR)
Title (original language):
Title (English): METHODS FOR THE SUBJECTIVE ASSESSMENT OF SPEECH QUALITY IN THE MARITIME MOBILE- SATELLITE SERVICE - SECTION 8G - AVAILABILITY, PERFORMANCE OBJECTIVES AND INTERWORKING WITH TERRESTRIAL NETWORKS

Organization Abbreviation: ITU-R Document #: REPORT 764-2 Date: 1986-00-00
Organization: ITU-R INTERNATIONAL RADIO CONSULTATIVE COMMITTEE (CCIR)
Title (original language):
Title (English): INTERFERENCE AND NOISE PROBLEMS FOR MARITIME MOBILE-SATELLITE SYSTEMS USING FREQUENCIES IN THE REGION OF 1.5 AND 1.6 GHZ - SECTION 8G - AVAILABILITY, PERFORMANCE OBJECTIVES AND INTERWORKING WITH TERRESTRIAL NETWORKS

Organization Abbreviation: ITU-R Document #: REPORT 917-2 Date: 1990-00-00
Organization: ITU-R INTERNATIONAL RADIO CONSULTATIVE COMMITTEE (CCIR)
Title (original language):
Title (English): PERMISSIBLE LEVELS OF INTERFERENCE INTO TELEPHONE CHANNELS IN THE MARITIME MOBILE-SATELLITE SERVICE - - SECTION 8G - AVAILABILITY, PERFORMANCE OBJECTIVES AND INTERWORKING WITH TERRESTRIAL NETWORKS

Organization Abbreviation: ITU-R Document #: REPORT 918-1 Date: 1990-00-00
Organization: ITU-R INTERNATIONAL RADIO CONSULTATIVE COMMITTEE (CCIR)
Title (original language):
Title (English): AVAILABILITY OF COMMUNICATIONS CIRCUITS IN THE MARITIME MOBILE- SATELLITE SERVICE - SECTION 8G - AVAILABILITY, PERFORMANCE OBJECTIVES AND INTERWORKING WITH TERRESTRIAL NETWORKS

Organization Abbreviation: ITU-R Document #: REPORT 1049-1 Date: 1990-00-00
Organization: ITU-R INTERNATIONAL RADIO CONSULTATIVE COMMITTEE (CCIR)
Title (original language):
Title (English): TERRESTRIAL NETWORKS CONTROL OF PASSIVE INTERMODULATION PRODUCTS - SECTION 8G - AVAILABILITY, PERFORMANCE OBJECTIVES AND INTERWORKING WITH

Organization Abbreviation: ITU-R Document #: REPORT 1176 Date: 1990-00-00
Organization: ITU-R INTERNATIONAL RADIO CONSULTATIVE COMMITTEE (CCIR)
Title (original language):
Title (English): INTERWORKING BETWEEN THE MOBILE SATELLITE SYSTEMS AND THE TERRESTRIAL NETWORKS FOR DATA TRANSMISSION SERVICES - SECTION 8G - AVAILABILITY, PERFORMANCE OBJECTIVES AND INTERWORKING WITH TERRESTRIAL NETWORKS

Organization Abbreviation: ITU-R Document #: REPORT 1177 Date: 1990-00-00
Organization: ITU-R INTERNATIONAL RADIO CONSULTATIVE COMMITTEE (CCIR)
Title (original language):
Title (English): INTEGRATION OF TERRESTRIAL AND SATELLITE LAND MOBILE SYSTEMS - SECTION 8G - AVAILABILITY, PERFORMANCE OBJECTIVES AND INTERWORKING WITH TERRESTRIAL NETWORKS

Organization Abbreviation: ITU-R Document #: RECMN 700 Date: 1990-00-00
Organization: ITU-R INTERNATIONAL RADIO CONSULTATIVE COMMITTEE (CCIR)
Title (original language):
Title (English): ERROR PERFORMANCE AND AVAILABILITY MEASUREMENT ALGORITHM FOR DIGITAL RADIO-RELAY LINKS AT THE SYSTEM BIT RATE INTERFACE - SECTION 9D1 - DIGITAL SYSTEMS

Organization Abbreviation: ITU-R Document #: RECMN 700-1 Date: 1992-00-00
Organization: ITU-R INTERNATIONAL RADIO CONSULTATIVE COMMITTEE (CCIR)
Title (original language):
Title (English): ERROR PERFORMANCE AND AVAILABILITY MEASUREMENT ALGORITHM FOR DIGITAL RADIO-RELAY LINKS AT THE BIT RATE INTERFACE - SECTION 9D1 - DIGITAL SYSTEMS

Organization Abbreviation: ITU-R Document #: REPORT 445-3 Date: 1986-00-00
Organization: ITU-R INTERNATIONAL RADIO CONSULTATIVE COMMITTEE (CCIR)
Title (original language):
Title (English): AVAILABILITY AND RELIABILITY OF RADIO- RELAY SYSTEMS - SECTION 9A - PERFORMANCE OBJECTIVES, PROPAGATION AND INTERFERENCE EFFECTS

Organization Abbreviation: ITU-R Document #: REPORT 639-2 Date: 1982-00-00
Organization: ITU-R INTERNATIONAL RADIO CONSULTATIVE COMMITTEE (CCIR)
Title (original language):
Title (English): AVAILABILITY OF AN INTERNATIONAL TELEVISION CIRCUIT OR CHAIN - SECTION CMTT B - METHODS OF OPERATION AND ASSESSMENT OF PERFORMANCE OF TELEVISION TRANSMISSIONS

Organization Abbreviation: ITU-R Document #: RECMN 828 Date: 1992-00-00
Organization: ITU-R INTERNATIONAL RADIO CONSULTATIVE COMMITTEE (CCIR)
Title (original language):
Title (English): DEFINITION OF AVAILABILITY FOR COMMUNICATION CIRCUITS IN THE MOBILE-SATELLITE SERVICES

Organization Abbreviation: ITU-R Document #: RECMN 842 Date: 1992-00-00
Organization: ITU-R INTERNATIONAL RADIO CONSULTATIVE COMMITTEE (CCIR)
Title (original language):
Title (English): COMPUTATION OF RELIABILITY OF HF RADIO SYSTEMS

Organization Abbreviation: ITU-T Document #: RECMN E.800 Date: 1989-00-00
Organization: ITU-T INTERNATIONAL TELEGRAPH &TELEPHONE CONSULTATIVE COMMITTEE (CCITT)
Title (original language):
Title (English): QUALITY OF SERVICE AND DEPENDABILITY VOCABULARY - TELEPHONE NETWORK AND ISDN - QUALITY OF SERVICE, NETWORK MANAGEMENT AND TRAFFIC ENGINEERING (STUDY GROUP II) 12 PP

Organization Abbreviation: ITU-T Document #: RECMN E.800 Date: 1994-00-00
Organization: ITU-T INTERNATIONAL TELEGRAPH &TELEPHONE CONSULTATIVE COMMITTEE (CCITT)
Title (original language):
Title (English): TERMS AND DEFINITIONS RELATED TO QUALITY OF SERVICE AND NETWORK PERFORMANCE INCLUDING DEPENDABILITY - TELEPHONE NETWORK AND ISDN QUALITY OF SERVICE, NETWORK MANAGEMENT AND TRAFFIC ENGINEERING (STUDY GROUP 2) 56 PP

Organization Abbreviation: ITU-T Document #: RECMN E.862 (REV 1) Date: 1992-00-00
Organization: ITU-T INTERNATIONAL TELEGRAPH &TELEPHONE CONSULTATIVE COMMITTEE (CCITT)
Title (original language):
Title (English): DEPENDABILITY PLANNING OF TELECOMMUNICATION NETWORKS (STUDY GROUP II) 16 PP

Organization Abbreviation: ITU-T Document # RECMN E.862 Date: 1989-00-00
Organization: ITU-T INTERNATIONAL TELEGRAPH &TELEPHONE CONSULTATIVE COMMITTEE (CCITT)
Title (original language):
Title (English): DEPENDABILITY PLANNING OF TELECOMMUNICATION NETWORKS - TELEPHONE NETWORK AND ISDN - QUALITY OF SERVICE, NETWORK MANAGEMENT AND TRAFFIC ENGINEERING (STUDY GROUP II) 12 PP

Organization Abbreviation: ITU-T Document #: RECMN G.602 Date: 1989-00-00
Organization: ITU-T INTERNATIONAL TELEGRAPH &TELEPHONE CONSULTATIVE COMMITTEE (CCITT)
Title (original language):
Title (English): RELIABILITY AND AVAILABILITY OF ANALOGUE CABLE TRANSMISSION SYSTEMS AND ASSOCIATED EQUIPMENTS - TRANSMISSION MEDIA CHARACTERISTICS - (STUDY GROUP XV) 4 PP

Organization Abbreviation: ITU-T Document #: RECMN G.911 Date: 1993-00-00
Organization: ITU-T INTERNATIONAL TELEGRAPH &TELEPHONE CONSULTATIVE COMMITTEE (CCITT)
Title (original language):
Title (English): PARAMETERS AND CALCULATION METHODOLOGIES FOR RELIABILITY AND AVAILABILITY OF FIBRE OPTIC SYSTEMS - DIGITAL SECTIONS AND DIGITAL LINE SYSTEMS (STUDY GROUP XV) 33 PP

Organization Abbreviation: ITU-T Document #: RECMN I.355 Date: 1993-00-00
Organization: ITU-T INTERNATIONAL TELEGRAPH &TELEPHONE CONSULTATIVE COMMITTEE (CCITT)
Title (original language):
Title (English): ISDN 64 KBIT/S CONNECTION TYPE AVAILABILITY PERFORMANCE (STUDY GROUP XVIII) 27 PP

Organization Abbreviation: ITU-T Document #: RECMN Q.276 Date: 1989-00-00
Organization: ITU-T INTERNATIONAL TELEGRAPH &TELEPHONE CONSULTATIVE COMMITTEE (CCITT)
Title (original language):
TITLE (ENGLISH): 6.6 SERVICE DEPENDABILITY - SPECIFICATIONS OF SIGNALLING SYSTEM NO. 6 (STUDY GROUP XI) 2 PP

Organization Abbreviation: CECC Document #: CECC 00 801 ISSUE 1 Date: 1990-00-00
Organization: CECC CENELEC ELECTRONIC COMPONENTS COMMITTEE (CECC)
Title (original language):
Title (English): PRELIMINARY GUIDANCE DOCUMENT: PI-Q FACTORS OF CECC APPROVED COMPONENTS FOR USE IN RELIABILITY PREDICTIONS (EN, FR, GE) AMD 1 (EN, FR, GE)

Organization Abbreviation: CECC Document #: CECC 00 804 ISSUE 1 Date: 1994-00-00
Organization: CECC CENELEC ELECTRONIC COMPONENTS COMMITTEE (CECC)
Title (original language):
Title (English): GUIDANCE DOCUMENT: INTERPRETATION OF "EN 29000" - RELIABILITY ASPECTS FOR ELECTRONIC COMPONENTS (EN, FR, GE)

Organization Abbreviation: CED Document #: TR GL-86-15 Date: 1986-00-00
Organization: CED CIVIL ENGINEERING DATA (CED)
Title (original language):
Title (English): PROBABILISTIC AND RELIABILITY ANALYSIS OF THE CALIFORNIA BEARING RATIO (CBR) DESIGN METHOD FOR FLEXIBLE AIRFIELD PAVEMENTS

Organization Abbreviation: CENELEC Document #: HD 485 Date: 1987-00-00
Organization: CENELEC EUROPEAN COMMITTEE FOR ELECTROTECHNICAL STANDARDIZATION (CENELEC)
Title (original language):
Title (English): ANALYSIS TECHNIQUES FOR SYSTEM RELIABILITY - PROCEDURE FOR FAILURE MODE AND EFFECTS ANALYSIS (FMEA)

Organization Abbreviation: CENELEC Document #: HD 485 S1 Date: 1987-00-00
Organization: CENELEC EUROPEAN COMMITTEE FOR ELECTROTECHNICAL STANDARDIZATION (CENELEC)
Title (original language):
Title (English): ANALYSIS TECHNIQUES FOR SYSTEM RELIABILITY - PROCEDURE FOR FAILURE MODE AND EFFECTS ANALYSIS (FMEA)

Organization Abbreviation: CENELEC Document #: HD 617 S1 Date: 1992-00-00
Organization: CENELEC EUROPEAN COMMITTEE FOR ELECTROTECHNICAL STANDARDIZATION (CENELEC)
Title (original language):
Title (English): FAULT TREE ANALYSIS (FTA)

Organization Abbreviation: CENELEC Document #: EN 61078 Date: 1993-00-00
Organization: CENELEC EUROPEAN COMMITTEE FOR ELECTROTECHNICAL STANDARDIZATION (CENELEC)
Title (original language):
Title (English): ANALYSIS TECHNIQUES FOR DEPENDABILITY - RELIABILITY BLOCK DIAGRAM METHOD (IEC 1078 : 1991)

Organization Abbreviation: CEPT Document #: T/N 45-01 E Date: 1988-00-00
Organization: CEPT CONFERENCE EUROPEENNE DESADMINISTRATIONS DES POSTES ET DES TELECOMMUNICATIONS (CEPT)
Title (original language):
Title (English): TESTING THE COMPLIANCE OF AN EQUIPMENT WITH ITS RELIABILITY, MAINTAINABILITY AND AVAILABILITY SPECIFICATIONS

Organization Abbreviation: CEPT Document #: T/TPH 41 E Date: 1988-00-00
Organization: CEPT CONFERENCE EUROPEENNE DESADMINISTRATIONS DES POSTES ET DES TELECOMMUNICATIONS (CEPT)
Title (original language):
Title (English): RELIABILITY OF ANALOGUE LEASED CIRCUITS

Organization Abbreviation: CEPT Document #: T/TPH 44 E Date: 1990-00-00
Organization: CEPT CONFERENCE EUROPEENNE DESADMINISTRATIONS DES POSTES ET DES TELECOMMUNICATIONS (CEPT)
Title (original language):
Title (English): RELIABILITY OF DIGITAL LEASED CIRCUITS

Organization Abbreviation: CNS Document #: B8006 Date: 1985-00-00
Organization: CNS CHINESE NATIONAL STANDARDS
Title (original language):
Title (English): GLOSSARY OF TERMS FOR RELIABILITY (GENERAL) (OCT)(11381)

Organization Abbreviation: CNS Document #: B8006-1 Date: 1985-00-00
Organization: CNS CHINESE NATIONAL STANDARDS
Title (original language):
Title (English): GLOSSARY OF TERMS FOR RELIABILITY (TERMS OF FAILURE) (OCT)(11381-1)

Organization Abbreviation: CNS Document #: B8006-2 Date: 1985-00-00
Organization: CNS CHINESE NATIONAL STANDARDS
Title (original language):
Title (English): GLOSSARY OF TERMS FOR RELIABILITY (TERMS OF MAINTAINABILITY) (OCT)(11381-2)

Organization Abbreviation: CNS Document # B8006-3 Date: 1985-00-00
Organization: CNS CHINESE NATIONAL STANDARDS
Title (original language):
Title (English): GLOSSARY OF TERMS FOR RELIABILITY (TERMS OF DESIGN) (OCT)(11381-3)

Organization Abbreviation: CNS Document #: B8006-4 Date: 1985-00-00
Organization: CNS CHINESE NATIONAL STANDARDS
Title (original language):
Title (English): GLOSSARY OF TERMS FOR RELIABILITY (TERMS OF TEST) (OCT)(11381-4)

Organization Abbreviation: CNS Document #: B8006-5 Date: 1985-00-00
Organization: CNS CHINESE NATIONAL STANDARDS
Title (original language):
Title (English): GLOSSARY OF TERMS FOR RELIABILITY (TERMS OF TIME) (OCT)(11381-5)

Organization Abbreviation: CNS Document #: B8006-6 Date: 1985-00-00
Organization: CNS CHINESE NATIONAL STANDARDS
Title (original language):
Title (English): GLOSSARY OF TERMS FOR RELIABILITY (TERMS OF MANAGEMENT AND DISTRIBUTION) (OCT)(11381-6)

Organization Abbreviation: CNS Document #: C5039 Date: 1980-00-00
Organization: CNS CHINESE NATIONAL STANDARDS
Title (original language):
Title (English): CRITERIA FOR INSPECTION FOR HIGHLY RELIABLE SOLDERED CONNECTION IN ELECTRONIC AND ELECTRICAL APPLICATIONS (APR)(5429)

Organization Abbreviation: CNS Document #: C5155 Date: 1985-00-00
Organization: CNS CHINESE NATIONAL STANDARDS
Title (original language):
Title (English): DATA PROCESSING VOCABULARY (PART 14: RELIABILITY, MAINTENANCE AND AVAILABILITY) (AUG)(10242)

Organization Abbreviation: CNS Document #: C6303 Date: 1987-00-00
Organization: CNS CHINESE NATIONAL STANDARDS
Title (original language):
Title (English): METHOD OF TEST FOR RELIABILITY OF HOUSEHOLD AUDIO PRODUCT (OCT)(12120)

Organization Abbreviation: CNS Document #: C6304 Date: 1987-00-00
Organization: CNS CHINESE NATIONAL STANDARDS
Title (original language):
Title (English): METHOD OF TEST FOR RELIABILITY OF VIDEO PRODUCT (OCT)(12121)

Organization Abbreviation: MOD UK Document #: DSTAN 00-40: PART 1 Date: 1987-00-00
Organization: MOD UK BRITISH DEFENCE STANDARDS(MOD UK)
Title (original language):
Title (English): RELIABILITY AND MAINTAINABILITY PART 1: MANAGEMENT RESPONSIBILITIES AND REQUIREMENTS FOR PROGRAMMES AND PLANS ISSUE 2 (07.87) (ARMP-1)

Organization Abbreviation: MOD UK Document #: DSTAN 00-40: PART 1 Date: 1994-00-00
Organization: MOD UK BRITISH DEFENCE STANDARDS(MOD UK)
Title (original language):
Title (English): RELIABILITY AND MAINTAINABILITY PART 1: MANAGEMENT RESPONSIBILITIES AND REQUIREMENTS FOR PROGRAMMES AND PLANS ISSUE 3 (12.94) (ARMP-1) (SUPERSEDES DEF STAN 00-5: PART 0)

Organization Abbreviation: MOD UK Document #: DSTAN 00-40: PART 2 Date: 1988-00-00
Organization: MOD UK BRITISH DEFENCE STANDARDS(MOD UK)
Title (original language):
Title (English): RELIABILITY AND MAINTAINABILITY PART 2: GENERAL APPLICATION GUIDANCE ON THE USE OF PART 1 (ARMP-1) ISSUE 1 (06.88) (ARMP-2)

Organization Abbreviation: MOD UK Document #: DSTAN 00-40: PART 2 Date: 1994-00-00
Organization: MOD UK BRITISH DEFENCE STANDARDS(MOD UK)
Title (original language):
Title (English): RELIABILITY AND MAINTAINABILITY PART 2: GENERAL APPLICATION GUIDANCE ON THE USE OF PART 1 ISSUE 2 (12.94) (ARMP-2)

Organization Abbreviation: MOD UK Document #: DSTAN 00-40: PART 3 Date: 1989-00-00
Organization: MOD UK BRITISH DEFENCE STANDARDS(MOD UK)
Title (original language):
Title (English): MOD PRACTICES AND PROCEDURES FOR RELIABILITY AND MAINTAINABILITY PART 3: APPLICATION OF NATIONAL R AND M DOCUMENTS ISSUE 1 (08.89) (ARMP-3)

Organization Abbreviation: MOD UK Document #: DSTAN 00-40: PART 4 Date: 1991-00-00
Organization: MOD UK BRITISH DEFENCE STANDARDS(MOD UK)
Title (original language):
Title (English): RELIABILITY AND MAINTAINABILITY PART 4: GUIDANCE FOR WRITING NATO R & M REQUIREMENTS DOCUMENTS ISSUE 1 (09.91) (ARMP-4)

Organization Abbreviation: MOD UK Document #: DSTAN 00-40: PART 5 Date: 1989-00-00
Organization: MOD UK BRITISH DEFENCE STANDARDS(MOD UK)
Title (original language):
Title (English): RELIABILITY AND MAINTAINABILITY PART 5: GUIDANCE ON R & M TRAINING ISSUE 1 (02.89) (ARMP-5)

Organization Abbreviation: MOD UK Document #: DSTAN 00-40: PART 6 Date: 1988-00-00
Organization: MOD UK BRITISH DEFENCE STANDARDS(MOD UK)
Title (original language):
Title (English): RELIABILITY AND MAINTAINABILITY PART 6: IN-SERVICE R & M ISSUE 1 (12.88) (ARMP-6)

Organization Abbreviation: MOD UK Document #: DSTAN 00-40: PART 8 Date: 1992-00-00
Organization: MOD UK BRITISH DEFENCE STANDARDS(MOD UK)
Title (original language):
Title (English): RELIABILITY AND MAINTAINABILITY PART 8: PROCUREMENT OF OFF - THE - SHELF EQUIPMENT (ARMP - 8) ISSUE 1 (07.92)

Organization Abbreviation: MOD UK Document #: DSTAN 00-41 Date: 1993-00-00
Organization: MOD UK BRITISH DEFENCE STANDARDS(MOD UK)
Title (original language):
Title (English): RELIABILITY AND MAINTAINABILITY MOD GUIDE TO PRACTICES AND PROCEDURES ISSUE 3 (06.93) (SUPERSEDES ALL PREVIOUSLY ISSUED SEPARATE PARTS)

Organization Abbreviation: MOD UK Document #: DSTAN 00-41: PART 1 Date: 1989-00-00
Organization: MOD UK BRITISH DEFENCE STANDARDS(MOD UK)
Title (original language):
Title (English): MOD PRACTICES AND PROCEDURES FOR RELIABILITY AND MAINTAINABILITY PART 1: RELIABILITY DESIGN PHILOSOPHY ISSUE 2 (05.89) (SUPERSEDED BY DEF STAN 00-41)

Organization Abbreviation: MOD UK Document #: DSTAN 00-41: PART 2 Date: 1989-00-00
Organization: MOD UK BRITISH DEFENCE STANDARDS(MOD UK)
Title (original language):
Title (English): MOD PRACTICES AND PROCEDURES FOR RELIABILITY AND MAINTAINABILITY PART 2: RELIABILITY APPORTIONMENT, MODELLING AND CALCULATION ISSUE 2 (10.89) (SUPERSEDED BY DEF STAN 00-41)

Organization Abbreviation: MOD UK Document #: DSTAN 00-41: PART 3 Date: 1989-00-00
Organization: MOD UK BRITISH DEFENCE STANDARDS(MOD UK)
Title (original language):
Title (English): MOD PRACTICES AND PROCEDURES FOR RELIABILITY AND MAINTAINABILITY PART 3: RELIABILITY PREDICTION ISSUE 2 (07.89) (SUPERSEDED BY DEF STAN 00-41)

Organization Abbreviation: MOD UK Document #: DSTAN 00-41: PART 3(A) Date: 1984-00-00
Organization: MOD UK BRITISH DEFENCE STANDARDS(MOD UK)
Title (original language):
Title (English): MOD PRACTICES AND PROCEDURES FOR RELIABILITY AND MAINTAINABILITY PART 3: RELIABILITY PREDICTION SUPPLEMENT A - QUALITY FACTORS ISSUE 1 (12.84) (SUPERSEDED BY DEF STAN 00-41)

Organization Abbreviation: MOD UK Document #: DSTAN 00-41: PART 4 Date: 1989-00-00
Organization: MOD UK BRITISH DEFENCE STANDARDS(MOD UK)
Title (original language):
Title (English): MOD PRACTICES AND PROCEDURES FOR RELIABILITY AND MAINTAINABILITY PART 4: RELIABILITY ENGINEERING ISSUE 2 (09.89) (SUPERSEDED BY DEF STAN 00-41)

Organization Abbreviation: MOD UK Document #: DSTAN 00-41: PART 5 Date: 1989-00-00
Organization: MOD UK BRITISH DEFENCE STANDARDS(MOD UK)
Title (original language):
Title (English): MOD PRACTICES AND PROCEDURES FOR RELIABILITY AND MAINTAINABILITY PART 5: RELIABILITY TESTING AND SCREENING ISSUE 2 (07.89) (SUPERSEDED BY DEF STAN 00-41)

Organization Abbreviation: MOD UK Document #: DSTAN 00-41: PART 6 Date: 1989-00-00
Organization: MOD UK BRITISH DEFENCE STANDARDS(MOD UK)
Title (original language):
Title (English): MOD PRACTICES AND PROCEDURES FOR RELIABILITY AND MAINTAINABILITY PART 6: MAINTAINABILITY ISSUE 1 (11.89) (SUPERSEDED BY DEF STAN 00-41)

Organization Abbreviation: MOD UK Document #: DSTAN 05-63 Date: 1984-00-00
Organization: MOD UK BRITISH DEFENCE STANDARDS(MOD UK)
Title (original language):
Title (English): GUIDELINES FOR CLASSIFYING INCIDENTS FOR RELIABILITY ESTIMATION OF TRACKED AND WHEELED VEHICLES ISSUE 1 (10.84)

Organization Abbreviation: MOD UK Document #: NES 1017 Date: 1989-00-00
Organization: MOD UK BRITISH DEFENCE STANDARDS(MOD UK)
Title (original language):
Title (English): REQUIREMENTS FOR MAINTAINABILITY DEMONSTRATIONS OF NAVAL WEAPONS EQUIPMENT ISSUE 1 (02.89)

Organization Abbreviation: MOD UK Document #: NES 1017 Date: 1991-00-00
Organization: MOD UK BRITISH DEFENCE STANDARDS(MOD UK)
Title (original language):
Title (English): REQUIREMENTS FOR MAINTAINABILITY DEMONSTRATIONS OF NAVAL SYSTEMS ISSUE 2 (10.91)

Organization Abbreviation: MOD UK Document #: NES 1017 Date: 1993-00-00
Organization: MOD UK BRITISH DEFENCE STANDARDS(MOD UK)
Title (original language):
Title (English): REQUIREMENTS FOR MAINTAINABILITY DEMONSTRATIONS OF NAVAL SYSTEMS ISSUE 3 (01.93)

Organization Abbreviation: DIN/VDE Document #: DIN EN 50126-0*VDE 0115 Teil 103-0 Date: 1994-10-00
Organization: DIN/VDE DIN DEUTSCHES INSTITUT FÜR NORMUNG E.V. / VERBAND DEUTSCHER ELEKTROTECHNIKER E.V. (VDE)
Title (original language): BAHNANWENDUNGEN - SPEZIFIKATION UND NACHWEIS DER FUNKTIONSFAEHIGKEIT, VERFUEGBARKEIT, INSTANDHALTBARKEIT, SICHERHEIT (RAMS) - TEIL 0: ZUVERLAESSIGKEIT; DEUTSCHE FASSUNG PREN 50126-0:1994
Title (English): RAILWAY APPLICATIONS - THE SPECIFICATION AND DEMONSTRATION OF RELIABILITY, AVAILABILITY, MAINTAINABILITY AND SAFETY (RAMS) - PART 0: DEPENDABILITY; GERMAN VERSION PREN 50126-0:1994

Organization Abbreviation: DIN/VDE Document #: DIN EN 50126-1*VDE 0115 Teil 103-1 Date: 1994-10-00
Organization: DIN/VDE DIN DEUTSCHES INSTITUT FÜR NORMUNG E.V. / VERBAND DEUTSCHER ELEKTROTECHNIKER E.V. (VDE)
Title (original language): BAHNANWENDUNGEN - SPEZIFIKATION UND NACHWEIS DER FUNKTIONSFAEHIGKEIT, VERFUEGBARKEIT, INSTANDHALTBARKEIT, SICHERHEIT (RAMS) - TEIL 1: RAM; DEUTSCHE FASSUNG PREN 50126-1:1994
Title (English): RAILWAY APPLICATIONS - THE SPECIFICATION AND DEMONSTRATION OF RELIABILITY, AVAILABILITY, MAINTAINABILITY AND SAFETY (RAMS) - PART 1: RAM; GERMAN VERSION PREN 50126-1:1994

Organization Abbreviation: DIN/VDE Document #: DIN EN 50126-2*VDE 0115 Teil 103-2 Date: 1994-10-00
Organization: DIN/VDE DIN DEUTSCHES INSTITUT FÜR NORMUNG E.V. / VERBAND DEUTSCHER ELEKTROTECHNIKER E.V. (VDE)
Title (original language): BAHNANWENDUNGEN - SPEZIFIKATION UND NACHWEIS DER FUNKTIONSFAEHIGKEIT, VERFUEGBARKEIT, INSTANDHALTBARKEIT, SICHERHEIT (RAMS) - TEIL 2: SICHERHEIT; DEUTSCHE FASSUNG PREN 50126-2:1994
Title (English): RAILWAY APPLICATIONS - THE SPECIFICATION AND DEMONSTRATION OF RELIABILITY, AVAILABILITY, MAINTAINABILITY AND SAFETY (RAMS) - PART 2: SAFETY; GERMAN VERSION PREN 50126-2:1994

Organization Abbreviation: DIN Document #: DIN 25424-1 Date: 1981-09-00
Organization: DIN DIN DEUTSCHES INSTITUT FÜR NORMUNG E.V.
Title (original language): FEHLERBAUMANALYSE; METHODE UND BILDZEICHEN
Title (English): FAULT TREE ANALYSIS; METHOD AND GRAPHICAL SYMBOLS

Organization Abbreviation: DIN Document #: DIN 25424-2 Date: 1990-04-00
Organization: DIN DIN DEUTSCHES INSTITUT FÜR NORMUNG E.V.
Title (original language): FEHLERBAUMANALYSE; HANDRECHENVERFAHREN ZUR AUSWERTUNG EINES FEHLERBAUMES
Title (English): FAULT TREE ANALYSIS; MANUAL CALCULATION PROCEDURES FOR THE EVALUATION OF A FAULT TREE

Organization Abbreviation: DIN Document #: DIN 25448 Date: 1990-05-00
Organization: DIN DIN DEUTSCHES INSTITUT FÜR NORMUNG E.V.
Title (original language): AUSFALLEFFEKTANALYSE (FEHLER-MOEGLICHKEITS- UND -EINFLUSS-ANALYSE)
Title (English): FAILURE MODE AND EFFECTS ANALYSIS (FMEA)

Organization Abbreviation: DIN Document #: DIN 40041 Date: 1990-12-00
Organization: DIN DIN DEUTSCHES INSTITUT FÜR NORMUNG E.V.
Title (original language): ZUVERLAESSIGKEIT; BEGRIFFE
Title (English): DEPENDABILITY; CONCEPTS

Organization Abbreviation: DIN Document #: DIN 40081-11 Date: 1976-11-00
Organization: DIN DIN DEUTSCHES INSTITUT FÜR NORMUNG E.V.
Title (original language): LEITFAEDEN ZUR ZUVERLAESSIGKEIT; BAUELEMENTE DER ELEKTRONIK, LOSWEISE UND PERIODISCHE PRUEFUNGEN
Title (English): GUIDANCE TO RELIABILITY; ELECTRONIC COMPONENTS, LOT BY LOT AND PERIODIC INSPECTION PROCEDURES

Organization Abbreviation: DIN Document #: DIN 41794-2 Date: 1972-06-00
Organization: DIN DIN DEUTSCHES INSTITUT FÜR NORMUNG E.V.
Title (original language): ZUVERLAESSIGKEITSANGABEN FUER EINZEL-HALBLEITERBAUELEMENTE UND INTEGRIERTE SCHALTUNGEN; DARSTELLUNGSWEISE
Title (English): RELIABILITY DETAILS TO BE GIVEN IN DATA SHEETS; MODE OF REPRESENTATION

Organization Abbreviation: DIN Document #: DIN 45921-401*CECC 40401 Date: 1989-09-00
Organization: DIN DIN DEUTSCHES INSTITUT FÜR NORMUNG E.V.
Title (original language): HARMONISIERTES GUETEBESTAETIGUNGSSYSTEM FUER BAUELEMENTE DER ELEKTRONIK; VORDRUCK FUER BAUARTSPEZIFIKATION: NIEDRIG BELASTBARE NICHTDRAHTGEWICKELTE FESTWIDERSTAENDE FUER OBERFLAECHENMONTAGE (CHIPWIDERSTAENDE) (CECC 40401)
Title (English): HARMONIZED SYSTEM OF QUALITY ASSESSMENT FOR ELECTRONIC COMPONENTS; BLANK DETAIL SPECIFICATION: FIXED LOW POWER NON-WIREWOUND SURFACE MOUNTING (CHIP) RESISTORS

Organization Abbreviation: DIN Document #: DIN 58936-2 Date: 1989-04-00
Organization: DIN DIN DEUTSCHES INSTITUT FÜR NORMUNG E.V.
Title (original language): QUALITAETSSICHERUNG IN DER LABORATORIUMSMEDIZIN; BEGRIFFE ZUR QUALITAET UND ANWENDUNG VON KLASSIERUNGS-, ZAEHL- UND MESSSYSTEMEN
Title (English): QUALITY ASSURANCE IN LABORATORY MEDICINE; TERMINOLOGY FOR QUALITY AND APPLICATION OF CLASSIFICATION, COUNTING AND MEASURING SYSTEMS

Organization Abbreviation: DIN Document #: DIN EN 61078 Date: 1994-10-00
Organization: DIN DIN DEUTSCHES INSTITUT FÜR NORMUNG E.V.
Title (original language): TECHNIKEN FUER DIE ANALYSE DER ZUVERLAESSIGKEIT - VERFAHREN MIT ZUVERLAESSIGKEITSBLOCKDIAGRAMM (IEC 1078:1991); DEUTSCHE FASSUNG EN 61078:1993
Title (English): ANALYSIS TECHNIQUES FOR DEPENDABILITY - RELIABILITY BLOCK DIAGRAM METHOD (IEC 1078:1991); GERMAN VERSION EN 61078:1993

Organization Abbreviation: DIN Document #: DIN IEC 1/1504-191 Date: 1995-07-00
Organization: DIN DIN DEUTSCHES INSTITUT FÜR NORMUNG E.V.
Title (original language): INTERNATIONALES ELEKTROTECHNISCHES WOERTERBUCH - AENDERUNG 1 ZU KAPITEL 191: ZUVERLAESSIGKEIT UND DIENSTGUETE - TEIL 1: ZUVERLAESSIGKEIT; ALLGEMEINE BEGRIFFE (IEC 1/1504/CD:1994)
Title (English): INTERNATIONAL ELECTROTECHNICAL VOCABULARY - AMENDMENT 1 TO PUBLICATION 50(191) (1990) IEV CHAPTER 191: DEPENDABILITY AND QUALITY OF SERVICE - PART 1: DEPENDABILITY; COMMON TERMS (IEC 1/1504/CD:1994)

Organization Abbreviation: DIN Document #: DIN IEC 47C/85/CD Date: 1995-04-00
Organization: DIN DIN DEUTSCHES INSTITUT FÜR NORMUNG E.V.
Title (original language): ZUVERLAESSIGKEITSBEWERTUNG VON LASER-MODULEN (IEC 47C/85/CD:1994)
Title (English): RELIABILITY ASSESSMENT OF LASER MODULES (IEC 47C/85/CD:1994)

Organization Abbreviation: DIN Document #: DIN IEC 48B(Sec)286 Date: 1994-02-00
Organization: DIN DIN DEUTSCHES INSTITUT FÜR NORMUNG E.V.
Title (original language): TECHNISCHER BERICHT; LEITFADEN FUER DIE BEURTEILUNG DER ZUVERLAESSIGKEIT VON ELEKTRISCHEN STECKVERBINDERN (IEC 48B(SEC)286:1993)
Title (English): TECHNICAL REPORT; GUIDE FOR ESTIMATING THE RELIABILITY OF ELECTRICAL CONNECTORS (IEC 48B(SECRETARIAT)286:1993)

Organization Abbreviation: DIN Document #: DIN IEC 50-191 Date: 1994-08-00
Organization: DIN DIN DEUTSCHES INSTITUT FÜR NORMUNG E.V.
Title (original language): INTERNATIONALES ELEKTROTECHNISCHES WOERTERBUCH - TEIL 191: ZUVERLAESSIGKEIT UND DIENSTGUETE (IEC 50(191):1990)
Title (English): INTERNATIONAL ELECTROTECHNICAL VOCABULARY - CHAPTER 191: DEPENDABILITY AND QUALITY OF SERVICE (IEC 50(191):1990)

Organization Abbreviation: DIN Document #: DIN IEC 56(CO)85 Date: 1984-05-00
Organization: DIN DIN DEUTSCHES INSTITUT FÜR NORMUNG E.V.
Title (original language): ELEKTROTECHNIK; ZUVERLAESSIGKEIT VON SYSTEMEN; UNTERSUCHUNGSTECHNIKEN; TEIL 2: AUSFALLARTEN- UND AUSFALLAUSWIRKUNGSANALYSE (FMEA)
Title (English): ANALYSIS TECHNIQUES FOR SYSTEM RELIABILITY; PART 2: PROCEDURE FOR FAILURE MODE AND EFFECTS ANALYSIS (FMEA)

Organization Abbreviation: DIN Document #: DIN IEC 56(CO)106 Date: 1985-11-00
Organization: DIN DIN DEUTSCHES INSTITUT FÜR NORMUNG E.V.
Title (original language): ELEKTROTECHNIK; PRUEFUNG DER ZUVERLAESSIGKEIT VON GERAETEN; TEIL 2: ANLEITUNG FUER DIE FESTLEGUNG VON PRUEFZYKLEN; IDENTISCH MIT IEC 56(CENTRAL OFFICE)106
Title (English): ELECTRICAL ENGINEERING; EQUIPMENT RELIABILITY TESTING; PART 2: GUIDANCE FOR THE DESIGN OF TEST CYCLES FOR EQUIPMENT RELIABILITY TESTING; IDENTICAL WITH IEC 56(CENTRAL OFFICE)106

Organization Abbreviation: DIN Document #: DIN IEC 56(CO)109 Date: 1985-11-00
Organization: DIN DIN DEUTSCHES INSTITUT FÜR NORMUNG E.V.
Title (original language): ELEKTROTECHNIK; LEITFADEN ZUR INSTANDHALTBARKEIT VON GERAETEN; HAUPTABSCHNITT 5: INSTANDHALTBARKEITSSTUDIEN WAEHREND DER ENTWICKLUNGSPHASE; IDENTISCH MIT IEC 56(CO)109
Title (English): ELECTRICAL ENGINEERING; GUIDE ON MAINTAINABILITY OF EQUIPMENT; SECTION 5: MAINTAINABILITY STUDIES DURING THE DESIGN PHASE; IDENTICAL WITH IEC 56(CENTRAL OFFICE)109

Organization Abbreviation: DIN Document #: DIN IEC 56(CO)148 Date: 1989-12-00
Organization: DIN DIN DEUTSCHES INSTITUT FÜR NORMUNG E.V.
Title (original language): ELEKTROTECHNIK; LEITFADEN FUER FORMALE ENTWURFSPRUEFUNGEN; IDENTISCH MIT IEC 56(CO)148
Title (English): ELECTRICAL ENGINEERING; GUIDE ON FORMAL DESIGN REVIEW; IDENTICAL WITH IEC 56 (CENTRAL OFFICE)148

Organization Abbreviation: DIN Document #: DIN IEC 56(CO)150 Date: 1991-02-00
Organization: DIN DIN DEUTSCHES INSTITUT FÜR NORMUNG E.V.
Title (original language): Elektrotechnik; Zuverlaessigkeitswachstum; Modelle und Schaetzverfahren; Identisch mit IEC 56(CO)150
Title (English): ELECTRICAL ENGINEERING; RELIABILITY GROWTH; MODELS AND ESTIMATION METHODS; IDENTICAL WITH IEC 56(CENTRAL OFFICE)150

Organization Abbreviation: DIN Document #: DIN IEC 56(CO)154 Date: 1990-05-00
Organization: DIN DIN DEUTSCHES INSTITUT FÜR NORMUNG E.V.
Title (original language): ELEKTROTECHNIK; ZUVERLAESSIGKEITSVORBEHANDLUNG DURCH BEANSPRUCHUNG, INSTANDSETZBARE EINHEITEN, LOSWEISE GEFERTIGT; IDENTISCH MIT IEC 56(CO)154
Title (English): ELECTRICAL ENGINEERING; RELIABILITY STRESS SCREENING OF REPAIRABLE ITEMS MANUFACTURED IN LOTS; IDENTICAL WITH IEC 56(CENTRAL OFFICE)154

Organization Abbreviation: DIN Document #: DIN IEC 56(CO)156 Date: 1992-07-00
Organization: DIN DIN DEUTSCHES INSTITUT FÜR NORMUNG E.V.
Title (original language): LEITFADEN FUER DIE ERFASSUNG VON ZUVERLAESSIGKEITSDATEN IM BETRIEB; IDENTISCH MIT IEC 56(CO)156
Title (English): GUIDELINES FOR THE COLLECTION OF DEPENDABILITY RELATED DATA FROM THE FIELD; IDENTICAL WITH IEC 56(CENTRAL OFFICE)156

Organization Abbreviation: DIN Document #: DIN IEC 56(CO)157 Date: 1992-07-00
Organization: DIN DIN DEUTSCHES INSTITUT FÜR NORMUNG E.V.
Title (original language): ELEKTROTECHNIK; LEITFADEN ZUR INSTANDHALTBARKEIT VON GERAETEN; TEIL 4: DIAGNOSTISCHES PRUEFEN, MATHEMATISCHE ABLEITUNGEN FUER DIAGNOSTISCHES PRUEFEN; IDENTISCH MIT IEC 56(CO)157
Title (English): ELECTRICAL ENGINEERING; GUIDE ON MAINTAINABILITY OF EQUIPMENT; PART 4: DIAGNOSTIC TESTING, MATHEMATICAL CONCEPTS IN DIAGNOSTIC TESTING; IDENTICAL WITH IEC 56(CENTRAL OFFICE)157

Organization Abbreviation: DIN Document #: DIN IEC 56(CO)160 Date: 1992-07-00
Organization: DIN DIN DEUTSCHES INSTITUT FÜR NORMUNG E.V.
Title (original language): ELEKTROTECHNIK; LEITFADEN ZUR INSTANDHALTBARKEIT VON GERAETEN; TEIL 4: DIAGNOSTISCHES PRUEFEN; IDENTISCH MIT IEC 56(CO)160
Title (English): ELECTRICAL ENGINEERING; GUIDE ON MAINTAINABILITY OF EQUIPMENT; PART 4: DIAGNOSTIC TESTING; IDENTICAL WITH IEC 56(CENTRAL OFFICE)160

Organization Abbreviation: DIN Document #: DIN IEC 56(CO)162 Date: 1992-07-00
Organization: DIN DIN DEUTSCHES INSTITUT FÜR NORMUNG E.V.
Title (original language): ANPASSUNGSTESTS, BESTIMMUNG DER VERTRAUENSBEREICHE UND DER UNTEREN GRENZE DES VERTRAUENSBEREICHES FUER DATEN, DIE EINER WEIBULL-VERTEILUNG FOLGEN; IDENTISCH MIT IEC 56(CO)162
Title (English): PROCEDURES FOR GOODNESS-OF-FIT TESTS, CONFIDENCE INTERVALS AND LOWER CONFIDENCE LIMITS FOR WEILBULL DISTRIBUTED DATA; IDENTICAL WITH IEC 56(CENTRAL OFFICE)162

Organization Abbreviation: DIN Document #: DIN IEC 56(CO)164 Date: 1991-04-00
Organization: DIN DIN DEUTSCHES INSTITUT FÜR NORMUNG E.V.
Title (original language): ZUVERLAESSIGKEIT; ANWENDUNG DES MARKOFF-VERFAHRENS; IDENTISCH MIT IEC 56(CO)164
Title (English): DEPENDABILITY; APPLICATION OF MARKOV TECHNIQUES; IDENTICAL WITH IEC 56(CENTRAL OFFICE)164

Organization Abbreviation: DIN Document #: DIN IEC 56(CO)165 Date: 1992-06-00
Organization: DIN DIN DEUTSCHES INSTITUT FÜR NORMUNG E.V.
Title (original language): ELEKTROTECHNIK; AUSFALLRATENVORHERSAGE FUER EINHEITEN MIT SERIELLER ZUVERLAESSIGKEITSSTRUKTUR
Title (English): ELECTRICAL ENGINEERING; FAILURE RATE PREDICTION OF ITEMS HAVING A SERIES STRUCTURE; IDENTICAL WITH IEC 56(CENTRAL OFFICE)165

Organization Abbreviation: DIN Document #: DIN IEC 56/374/CDV Date: 1995-07-00
Organization: DIN DIN DEUTSCHES INSTITUT FÜR NORMUNG E.V.
Title (original language): PRAKTISCHE ANALYSETECHNIKEN DER FUNKTIONSFAEHIGKEIT - VERFAHREN FUER DEN VERGLEICH VON ZWEI KONSTANTEN AUSFALLRATEN UND ZWEI KONSTANTEN AUSFALL-(EREIGNIS-) -INTENSITAETEN (IEC 56/374/CDV:1994)
Title (English): PRACTICAL RELIABILITY ANALYSIS TECHNIQUES - PROCEDURES FOR COMPARISON OF TWO CONSTANT FAILURE RATES AND TWO CONSTANT FAILURE (EVENT) INTENSITIES (IEC 56/374/CDV:1994)

Organization Abbreviation: DIN Document #: DIN IEC 56/432/CD Date: 1995-07-00
Organization: DIN DIN DEUTSCHES INSTITUT FÜR NORMUNG E.V.
Title (original language): LEITFADEN ZUR ZUVERLAESSIGKEITSVORBEHANDLUNG DURCH BEANSPRUCHUNG - TEIL 2: ELEKTRONISCHE BAUELEMENTE (IEC 56/432/CD)
Title (English): GUIDE FOR RELIABILITY STRESS SCREENING - PART 2: ELECTRONIC COMPONENTS (IEC 56/432/CD)

Organization Abbreviation: DIN Document #: DIN IEC 56(Sec)162 Date: 1984-03-00
Organization: DIN DIN DEUTSCHES INSTITUT FÜR NORMUNG E.V.
Title (original language): ELEKTROTECHNIK; LEITFADEN ZUR INSTANDHALTBARKEIT VON GERAETEN; HAUPTABSCHNITT 4: AUSFALLERKENNUNGS- UND FEHLERLOKALISIERUNGSVERFAHREN
Title (English): DRAFT-IEC STANDARD 706: GUIDE ON MAINTAINABILITY OF EQUIPMENT; SECTION FOUR: TEST AND DIAGNOSTIC PROCEDURES

Organization Abbreviation: DIN Document #: DIN IEC 56(Sec)261 Date: 1988-12-00
Organization: DIN DIN DEUTSCHES INSTITUT FÜR NORMUNG E.V.
Title (original language): ELEKTROTECHNIK; PRUEFUNG DER ZUVERLAESSIGKEIT VON GERAETEN; EMPFOHLENE PRUEFBEDINGUNGEN; ORTSFESTE GERAETE AN TEILWEISE WETTERGESCHUETZTEN EINSATZORTEN; NIEDRIGER SIMULATIONSGRAD; IDENTISCH MIT IEC 56(SEC)261
Title (English): ELECTRICAL ENGINEERING; EQUIPMENT RELIABILITY TESTING; PREFERRED TEST CONDITIONS; EQUIPMENT FOR STATIONARY USE AT PARTIALLY WEATHERPROTECTED LOCATIONS; LOW DEGREE OF SIMULATION; IDENTICAL WITH IEC 56(SEC)261

Organization Abbreviation: DIN Document #: DIN IEC 56(Sec)283 Date: 1989-12-00
Organization: DIN DIN DEUTSCHES INSTITUT FÜR NORMUNG E.V.
Title (original language): ELEKTROTECHNIK; PRUEFUNG DER ZUVERLAESSIGKEIT VON GERAETEN; EMPFOHLENE PRUEFBEDINGUNGEN; TRAGBARE GERAETE IM FREIEN; NIEDRIGER SIMULATIONSGRAD; IDENTISCH MIT IEC 56(SEC)283
Title (English): ELECTRICAL ENGINEERING; EQUIPMENT RELIABILITY TESTING; PREFERRED TEST CONDITIONS; OUTDOOR TRANSPORTABLE EQUIPMENT; LOW DEGREE OF SIMULATION; IDENTICAL WITH IEC 56(SECRETARIAT)283

Organization Abbreviation: DIN Document #: DIN IEC 56(Sec)348 Date: 1992-03-00
Organization: DIN DIN DEUTSCHES INSTITUT FÜR NORMUNG E.V.
Title (original language): ZUVERLAESSIGKEITSVORHERSAGE FUER BAUELEMENTE DER ELEKTRONIK; REFERENZBEDINGUNGEN FUER DIE ANGABE VON AUSFALLRATEN UND MODELLE FUER DIE UMRECHNUNG ZWISCHEN UNTERSCHIEDLICHEN BEANSPRUCHUNGEN; IDENTISCH MIT IEC 56(SEC)348
Title (English): RELIABILITY PREDICTION OF COMPONENTS FOR USE IN ELECTRONIC EQUIPMENT; REFERENCE CONDITIONS FOR FAILURE RATE DATA AND MODELS FOR CONVERSION BETWEEN DIFFERENT CONDITIONS; IDENTICAL WITH IEC 56(SECRETARIAT)348

Organization Abbreviation: DIN Document #: DIN IEC 56(Sec)349 Date: 1992-11-00
Organization: DIN DIN DEUTSCHES INSTITUT FÜR NORMUNG E.V.
Title (original language): ZUVERLAESSIGKEITSMANAGEMENT; TEIL 3: LEITFADEN FUER ANWENDER; HAUPTABSCHNITT X: SOFTWARESPEZIFISCHE ASPEKTE DER ZUVERLAESSIGKEIT; IDENTISCH MIT IEC 56(SEC)349
Title (English): DEPENDABILITY MANAGEMENT; PART 3: APPLICATION GUIDE; SECTION X: SOFTWARE ASPECTS OF DEPENDABILITY; IDENTICAL WITH IEC 56(SECRETARIAT)349

Organization Abbreviation: DIN Document #: DIN IEC 56(Sec)351 Date: 1993-08-00
Organization: DIN DIN DEUTSCHES INSTITUT FÜR NORMUNG E.V.
Title (original language): FORMALE ENTWURFSPRUEFUNGEN; AENDERUNG 1 ZU IEC 1160:1992; IDENTISCH MIT IEC 56(SEC)351:1992
Title (English): FORMAL DESIGN REVIEW; AMENDMENT 1 TO IEC 1160:1992; IDENTICAL WITH IEC 56(SECRETARIAT)351:1992

Organization Abbreviation: DIN Document #: DIN IEC 56(Sec)354 Date: 1992-04-00
Organization: DIN DIN DEUTSCHES INSTITUT FÜR NORMUNG E.V.
Title (original language): ELEKTROTECHNIK; ZUVERLAESSIGKEITSVORBEHANDLUNG DURCH BEANSPRUCHUNG FUER ELEKTRONISCHE BAUELEMENTE; IDENTISCH MIT IEC 56(SEC)354
Title (English): ELECTRICAL ENGINEERING; RELIABILITY STRESS SCREENING OF ELECTRONIC COMPONENTS; IDENTICAL WITH IEC 56(SECRETARIAT)354

Organization Abbreviation: DIN Document #: DIN IEC 56(Sec)359 Date: 1992-10-00
Organization: DIN DIN DEUTSCHES INSTITUT FÜR NORMUNG E.V.
Title (original language): ZUVERLAESSIGKEITS-MANAGEMENT; TEIL 2: ZUVERLAESSIGKEITS-PROGRAMMELEMENTE UND -AUFGABEN; IEC 300-2; IDENTISCH MIT IEC 56(SEC)359
Title (English): DEPENDABILITY MANAGEMENT; PART 2: DEPENDABILITY PROGRAMME ELEMENTS AND TASKS; IEC 300-2; IDENTICAL WITH IEC 56(SECRETARIAT)359

Organization Abbreviation: DIN Document #: DIN IEC 56(Sec)363 Date: 1992-11-00
Organization: DIN DIN DEUTSCHES INSTITUT FÜR NORMUNG E.V.
Title (original language): ZUVERLAESSIGKEIT; PFLEGE UND VERBESSERUNG VON SOFTWARE; IDENTISCH MIT IEC 56(SEC)363
Title (English): DEPENDABILITY; SOFTWARE MAINTENANCE AND ENHACEMENT; IDENTICAL WITH IEC 56 (SECRETARIAT)363

Organization Abbreviation: DIN Document #: DIN IEC 56(Sec)373 Date: 1995-01-00
Organization: DIN DIN DEUTSCHES INSTITUT FÜR NORMUNG E.V.
Title (original language): ZUVERLAESSIGKEITSMANAGEMENT - ANWENDUNGSLEITFADEN - FESTLEGUNG DER ZUVERLAESSIGKEITSFORDERUNG (IEC 56(SEC)373:1994)
Title (English): DEPENDABILITY MANAGEMENT - APPLICATION GUIDE - SPECIFICATION OF DEPENDABILITY REQUIREMENTS (IEC 56(SEC)373:1994)

Organization Abbreviation: DIN Document #: DIN IEC 56(Sec)377 Date: 1994-11-00
Organization: DIN DIN DEUTSCHES INSTITUT FÜR NORMUNG E.V.
Title (original language): PRUEFUNG DER ZUVERLAESSIGKEIT VON GERAETEN - TEIL 3: EMPFOHLENE PRUEFBEDINGUNGEN; HAUPTABSCHNITT 5: PRUEFZYKLUS 5: MOBILE GERAETE AN LAND; NIEDRIGER SIMULATIONSGRAD (IEC 56(SEC)377:1994)
Title (English): EQUIPMENT RELIABILITY TESTING - PART 3: PREFERRED TEST CONDITIONS; SECTION 5: TEST CYCLE 5: GROUND MOBILE EQUIPMENT; LOW DEGREE OF SIMULATION (IEC 56(SEC)377:1994)

Organization Abbreviation: DIN Document #: DIN IEC 56(Sec)402 Date: 1995-07-00
Organization: DIN DIN DEUTSCHES INSTITUT FÜR NORMUNG E.V.
Title (original language): MATHEMATISCHE AUSDRUECKE FUER BEGRIFFE DER FUNKTIONSFAEHIGKEIT, INSTANDHALTBARKEIT UND VERFUEGBARKEIT (IEC 56(SEC)402:1994)
Title (English): MATHEMATICAL EXPRESSIONS FOR RELIABILITY, MAINTAINABILITY AND AVAILABILITY TERMS (IEC 56(SEC)402:1994)

Organization Abbreviation: DIN Document #: DIN IEC 65A(Sec)130 Date: 1992-08-00
Organization: DIN DIN DEUTSCHES INSTITUT FÜR NORMUNG E.V.
Title (original language): LEITTECHNIK INDUSTRIELLER PROZESSSE; ERMITTLUNG DER SYSTEMEIGENSCHAFTEN ZUM ZWECK DER EIGNUNGSBEURTEILUNG EINES SYSTEMS; TEIL 5: EIGNUNGSBEURTEILUNG DER SYSTEMBETRIEBSSICHERHEIT; IDENTISCH MIT IEC 65A(SEC)130
Title (English): INDUSTRIAL-PROCESS MEASUREMENT AND CONTROL; EVALUATION OF SYSTEM PROPERTIES FOR THE PURPOSE OF SYSTEM ASSESSMENT; PART 5: ASSESSMENT OF SYSTEM DEPENDABILITY; IDENTICAL WITH IEC 65A(SECRETARIAT)130

Organization Abbreviation: DIN Document #: DIN IEC 300-3-1 Date: 1994-02-00
Organization: DIN DIN DEUTSCHES INSTITUT FÜR NORMUNG E.V.
Title (original language): ZUVERLAESSIGKEITSMANAGEMENT; ANWENDUNGSLEITFADEN; TECHNIKEN FUER DIE ANALYSE DER ZUVERLAESSIGKEIT; IDENTISCH MIT IEC 300-3-1:1991
Title (English): DEPENDABILITY MANAGEMENT; APPLICATION GUIDE; ANALYSIS TECHNIQUES FOR DEPENDABILITY; IDENTICAL WITH IEC 300-3-1:1991

Organization Abbreviation: DIN Document #: DIN IEC 319 Date: 1981-12-00
Organization: DIN DIN DEUTSCHES INSTITUT FÜR NORMUNG E.V.
Title (original language): DARSTELLUNG VON ZUVERLAESSIGKEITSANGABEN VON BAUELEMENTEN DER ELEKTRONIK
Title (English): PRESENTATION OF RELIABILITY DATA ON ELECTRONIC COMPONENTS (OR PARTS)

Organization Abbreviation: DIN Document #: DIN IEC 409 Date: 1986-12-00
Organization: DIN DIN DEUTSCHES INSTITUT FÜR NORMUNG E.V.
Title (original language): ANLEITUNG FUER ZUVERLAESSIGKEITSFESTLEGUNGEN IN SPEZIFIKATIONEN FUER BAUELEMENTE (ODER BAUTEILE) DER ELEKTRONIK; IDENTISCH MIT IEC 409, AUSGABE 1981
Title (English): GUIDE FOR THE INCLUSION OF RELIABILITY CLAUSES INTO SPECIFICATIONS FOR COMPONENTS (OR PARTS) FOR ELECTRONIC EQUIPMENT

Organization Abbreviation: DIN Document #: DIN IEC 605-1 Date: 1986-03-00
Organization: DIN DIN DEUTSCHES INSTITUT FÜR NORMUNG E.V.
Title (original language): ELEKTROTECHNIK; PRUEFUNG DER ZUVERLAESSIGKEIT VON GERAETEN; ALLGEMEINE ANFORDERUNGEN; IDENTISCH MIT IEC 605-1, AUSGABE 1978
Title (English): ELECTRICAL ENGINEERING; EQUIPMENT RELIABILITY TESTING; GENERAL REQUIREMENTS; IDENTICAL WITH IEC 605-1, EDITION 1978

Organization Abbreviation: DIN Document #: DIN IEC 605-3-1 Date: 1988-11-00
Organization: DIN DIN DEUTSCHES INSTITUT FÜR NORMUNG E.V.
Title (original language): ELEKTROTECHNIK; PRUEFUNG DER ZUVERLAESSIGKEIT VON GERAETEN; EMPFOHLENE PRUEFBEDINGUNGEN; TRAGBARE GERAETE IN INNENRAEUMEN; NIEDRIGER SIMULATIONSGRAD; IDENTISCH MIT IEC 605-3-1:1986
Title (English): ELECTRICAL ENGINEERING; EQUIPMENT RELIABILITY TESTING; PREFERRED TEST CONDITIONS; INDOOR PORTABLE EQUIPMENT; LOW DEGREE OF SIMULATION; IDENTICAL WITH IEC 605-3-1:1986

Organization Abbreviation: DIN Document #: DIN IEC 605-3-2 Date: 1988-05-00
Organization: DIN DIN DEUTSCHES INSTITUT FÜR NORMUNG E.V.
Title (original language): ELEKTROTECHNIK; PRUEFUNG DER ZUVERLAESSIGKEIT VON GERAETEN; EMPFOHLENE PRUEFBEDINGUNGEN; ORTSFESTE GERAETE AN WETTERGESCHUETZTEN EINSATZORTEN; HOHER SIMULATIONSGRAD; IDENTISCH MIT IEC 605-3-2, AUSGABE 1986
Title (English): ELECTRICAL ENGINEERING; EQUIPMENT RELIABILITY TESTING; PREFERRED TEST CONDITIONS; EQUIPMENT FOR STATIONARY USE IN WEATHERPROTECTED LOCATIONS; HIGH DEGREE OF SIMULATION; IDENTICAL WITH IEC 605-3-2, EDITION 1986

Organization Abbreviation: DIN Document #: DIN IEC 605-3-4 Date: 1993-11-00
Organization: DIN DIN DEUTSCHES INSTITUT FÜR NORMUNG E.V.
Title (original language): PRUEFUNG DER ZUVERLAESSIGKEIT VON GERAETEN; EMPFOHLENE PRUEFBEDINGUNGEN; NICHT ORTSFEST BETRIEBENE GERAETE; NIEDRIGER SIMULATIONSGRAD; IDENTISCH MIT IEC 605-3-4:1992
Title (English): EQUIPMENT RELIABILITY TESTING; PREFERRED TEST CONDITIONS; EQUIPMENT FOR PORTABLE AND NON-STATIONARY USE; LOW DEGREE OF SIMULATION; IDENTICAL WITH IEC 605-3-4:1992

Organization Abbreviation: DIN Document #: DIN IEC 605-4 Date: 1988-05-00
Organization: DIN DIN DEUTSCHES INSTITUT FÜR NORMUNG E.V.
Title (original language): ELEKTROTECHNIK; PRUEFUNG DER ZUVERLAESSIGKEIT VON GERAETEN; TEIL 4: SCHAETZWERTE UND VERTRAUENSGRENZEN; IDENTISCH MIT IEC 605-4, AUSGABE 1986
Title (English): ELECTRICAL ENGINEERING; EQUIPMENT RELIABILITY TESTING; PART 4: PROCEDURES FOR DETERMINING POINT ESTIMATES AND CONFIDENCE LIMITS FROM EQUIPMENT RELIABILITY DETERMINATIONS TESTS; IDENTICAL WITH IEC 605-4, EDITION 1986

Organization Abbreviation: DIN Document #: DIN IEC 605-6 Date: 1988-05-00
Organization: DIN DIN DEUTSCHES INSTITUT FÜR NORMUNG E.V.
Title (original language): ELEKTROTECHNIK; PRUEFUNG DER ZUVERLAESSIGKEIT VON GERAETEN; TEIL 6: STATISTISCHER TEST ZUR BESTAETIGUNG EINER KONSTANTEN AUSFALLRATE; IDENTISCH MIT IEC 605-6, AUSGABE 1986
Title (English): ELECTRICAL ENGINEERING; EQUIPMENT RELIABILITY TESTING; PART 6: STATISTICAL TEST FOR THE VALIDITY OF A CONSTANT FAILURE RATE ASSUMPTION; IDENTICAL WITH IEC 605-6, EDITION 1986

Organization Abbreviation: DIN Document #: DIN IEC 605-7 Date: 1986-03-00
Organization: DIN DIN DEUTSCHES INSTITUT FÜR NORMUNG E.V.
Title (original language): ELEKTROTECHNIK; PRUEFUNG DER ZUVERLAESSIGKEIT VON GERAETEN; TEIL 7: PRUEFPLAENE FUER AUSFALLRATE UND MITTLEREN AUSFALLABSTAND BEI VERMUTETER KONSTANTER AUSFALLRATE; IDENTISCH MIT IEC 605-7, AUSGABE 1978
Title (English): ELECTRICAL ENGINEERING; EQUIPMENT RELIABILITY TESTING; PART 7: COMPLIANCE TEST PLANS FOR FAILURE RATE AND MEAN TIME BETWEEN FAILURES ASSUMING CONSTANT FAILURE RATE; IDENTICAL WITH IEC 605-7, EDITION 1978

Organization Abbreviation: DIN Document #: DIN IEC 706-1 Date: 1986-12-00
Organization: DIN DIN DEUTSCHES INSTITUT FÜR NORMUNG E.V.
Title (original language): ELEKTROTECHNIK; LEITFADEN ZUR INSTANDHALTBARKEIT VON GERAETEN; TEIL 1: HAUPTABSCHNITTE EINS, ZWEI UND DREI; EINFUEHRUNG, ANFORDERUNGEN UND INSTANDHALTBARKEITSPROGRAMM; IDENTISCH MIT IEC 706-1, AUSGABE 1982
Title (English): ELECTRICAL ENGINEERING; GUIDE ON MAINTAINABILITY OF EQUIPMENT; PART 1: SECTIONS-ONE, TWO AND THREE; INTRODUCTION, REQUIREMENTS AND MAINTAINABILITY PROGRAMME; IDENTICAL WITH IEC 706-1, EDITION 1982

Organization Abbreviation: DIN Document #: DIN IEC 706-3 Date: 1990-12-00
Organization: DIN DIN DEUTSCHES INSTITUT FÜR NORMUNG E.V.
Title (original language): ELEKTROTECHNIK; LEITFADEN ZUR INSTANDHALTBARKEIT VON GERAETEN; TEIL 3: HAUPTABSCHNITTE SECHS UND SIEBEN; NACHWEIS UND ERFASSUNG, ANALYSE UND DARSTELLUNG VON DATEN; IDENTISCH MIT IEC 706-3:1987
Title (English): ELECTRICAL ENGINEERING; GUIDE ON MAINTAINABILITY OF EQUIPMENT; PART 3: SECTIONS SIX AND SEVEN; VERIFICATION AND COLLECTION, ANALYSIS AND PRESENTATION OF DATA; IDENTICAL WITH IEC 706-3:1987

Organization Abbreviation: DIN Document #: DIN IEC 706-4 Date: 1995-07-00
Organization: DIN DIN DEUTSCHES INSTITUT FÜR NORMUNG E.V.
Title (original language): LEITFADEN ZUR INSTANDHALTBARKEIT VON GERAETEN - TEIL 4: HAUPTABSCHNITTE 8: PLANUNG DER INSTANDHALTUNG UND IHRER UNTERSTUETZUNG (IEC 706-4:1992)
Title (English): GUIDE ON MAINTAINABILITY OF EQUIPMENT - PART 4: SECTION 8: MAINTENANCE AND MAINTENANCE SUPPORT PLANNING (IEC 706-4:1992)

Organization Abbreviation: DIN Document #: DIN IEC 706-6 Date: 1995-07-00
Organization: DIN DIN DEUTSCHES INSTITUT FÜR NORMUNG E.V.
Title (original language): LEITFADEN ZUR INSTANDHALTBARKEIT VON GERAETEN - TEIL 6: HAUPTABSCHNITT 9: STATISTISCHE METHODEN IN DER INSTANDHALTBARKEITSBEWERTUNG (IEC 706-6:1994)
Title (English): GUIDE ON MAINTAINABILITY OF EQUIPMENT - PART 6: SECTION 9: STATISTICAL METHODS IN MAINTAINABILITY EVALUATION (IEC 706-6:1994)

Organization Abbreviation: DIN Document #: DIN IEC 863 Date: 1988-08-00
Organization: DIN DIN DEUTSCHES INSTITUT FÜR NORMUNG E.V.
Title (original language): ELEKTROTECHNIK; DARSTELLUNG VON ZUVERLAESSIGKEITSVORHERSAGEN; IDENTISCH MIT IEC 863:1986
Title (English): ELECTRICAL ENGINEERING; PRESENTATION OF RELIABILITY, MAINTAINABILITY AND AVAILABILITY PREDICTIONS; IDENTICAL WITH IEC 863:1986

Organization Abbreviation: DIN Document #: DIN IEC 1014 Date: 1993-01-00
Organization: DIN DIN DEUTSCHES INSTITUT FÜR NORMUNG E.V.
Title (original language): PROGRAMME ZUM ZUVERLAESSIGKEITSWACHSTUM; IDENTISCH MIT IEC 1014:1989
Title (English): PROGRAMMES FOR RELIABILITY GROWTH; IDENTICAL WITH IEC 1014:1989

Organization Abbreviation: DIN Document #: DIN IEC 1025 Date: 1993-12-00
Organization: DIN DIN DEUTSCHES INSTITUT FÜR NORMUNG E.V.
Title (original language): STOERUNGSBAUMANALYSE; IDENTISCH MIT IEC 1025:1990
Title (English): FAULT TREE ANALYSIS (FTA); IDENTICAL WITH IEC 1025:1990

Organization Abbreviation: DIN Document #: DIN IEC 1070 Date: 1992-08-00
Organization: DIN DIN DEUTSCHES INSTITUT FÜR NORMUNG E.V.
Title (original language): PRUEFVERFAHREN ZUM NACHWEIS EINER STATIONAEREN VERFUEGBARKEIT; IDENTISCH MIT IEC 1070:1991
Title (English): COMPLIANCE TEST PROCEDURES FOR STEADY-STATE AVAILABILITY; IDENTICAL WITH IEC 1070:1991

Organization Abbreviation: DIN Document #: DIN IEC 1123 Date: 1993-08-00
Organization: DIN DIN DEUTSCHES INSTITUT FÜR NORMUNG E.V.
Title (original language): PRUEFUNG DER ZUVERLAESSIGKEIT; PRUEFPLAENE ZUM NACHWEIS DES ERFOLGSQUOTIENTEN; IDENTISCH MIT IEC 1123:1991
Title (English): RELIABILITY TESTING; COMPLIANCE TEST PLANS FOR SUCCESS RATIO; IDENTICAL WITH IEC 1123:1991

Organization Abbreviation: DIN Document #: DIN ISO 8930 Date: 1991-03-00
Organization: DIN DIN DEUTSCHES INSTITUT FÜR NORMUNG E.V.
Title (original language): ALLGEMEINE GRUNDSAETZE FUER DIE ZUVERLAESSIGKEIT VON TRAGWERKEN; VERZEICHNIS DER GLEICHBEDEUTENDEN BEGRIFFE; IDENTISCH MIT ISO 8930:1987
Title (English): GENERAL PRINCIPLES ON RELIABILITY FOR STRUCTURES; LIST OF EQUIVALENT TERMS; IDENTICAL WITH ISO 8930:1987

Organization Abbreviation: DIN Document #: DIN ISO 9000-4 Date: 1994-06-00
Organization: DIN DIN DEUTSCHES INSTITUT FÜR NORMUNG E.V.
Title (original language): NORMEN ZU QUALITAETSMANAGEMENT UND ZUR DARLEGUNG VON QUALITAETSMANAGEMENTSYSTEMEN; LEITFADEN ZUM MANAGEMENT VON ZUVERLAESSIGKEITSPROGRAMMEN (IDENTISCH MIT ISO 9000-4:1993 BZW. IEC 300-1:1993); DEUTSCHE FASSUNG EN 60300-1:1993
Title (English): QUALITY MANAGEMENT AND QUALITY ASSURANCE STANDARDS; GUIDE TO DEPENDABILITY PROGRAMME MANAGEMENT (IDENTICAL WITH ISO 9000-4:1993 RESP. IEC 300-1:1993); GERMAN VERSION EN 60300-1:1993

Organization Abbreviation: DOD Document #: MIL-STD-470B Date: 1989-05-30
Organization: DOD DEPARTMENT OF DEFENSE
Title (original language):
Title (English): MAINTAINABILITY PROGRAM FOR SYSTEMS AND EQUIPMENT*

Organization Abbreviation: DOD Document #: MIL-STD-471A INT NOTICE 2 Date: 1978-12-08
Organization: DOD DEPARTMENT OF DEFENSE
Title (original language):
Title (English): MAINTAINABILITY VERIFICATION/DEMONSTRATION/EVALUATION*

Organization Abbreviation: DOD Document #: MIL-STD-690C Date: 1993-03-26
Organization: DOD DEPARTMENT OF DEFENSE
Title (original language):
Title (English): FAILURE RATE SAMPLING PLANS AND PROCEDURES*

Organization Abbreviation: DOD Document #: MIL-STD-721C VALID NOTICE 1 Date: 1991-10-23
Organization: DOD DEPARTMENT OF DEFENSE
Title (original language):
Title (English): DEFINITIONS OF TERMS FOR RELIABILITY AND MAINTAINABILITY*

Organization Abbreviation: DOD Document #: MIL-STD-756B NOTICE 1 Date: 1982-08-31
Organization: DOD DEPARTMENT OF DEFENSE
Title (original language):
Title (English): RELIABILITY MODELING AND PREDICTION*

Organization Abbreviation: DOD Document #: MIL-STD-781D Date: 1986-10-17
Organization: DOD DEPARTMENT OF DEFENSE
Title (original language):
Title (English): RELIABILITY TESTING FOR ENGINEERING DEVELOPMENT, QUALIFICATION, AND PRODUCTION*

Organization Abbreviation: DOD
Document #: MIL-STD-785B NOTICE 2
Date: 1988-08-05
Organization: DOD DEPARTMENT OF DEFENSE
Title (original language):
Title (English): RELIABILITY PROGRAM FOR SYSTEMS AND EQUIPMENT DEVELOPMENT AND PRODUCTION*

Organization Abbreviation: DOD
Document #: MIL-STD-790E NOTICE 1*
Date: 1990-07-27
Organization: DOD DEPARTMENT OF DEFENSE
Title (original language):
Title (English): PRODUCT ASSURANCE PROGRAM FOR ELECTRONIC AND FIBER OPTIC PARTS SPECIFICATIONS*

Organization Abbreviation: DOD
Document #: MIL-STD-1369 NOTICE 2
Date: 1977-10-18
Organization: DOD DEPARTMENT OF DEFENSE
Title (original language):
Title (English): INTEGRATED LOGISTIC SUPPORT PROGRAM REQUIREMENTS*

Organization Abbreviation: DOD
Document #: MIL-STD-1543B
Date: 1988-10-25
Organization: DOD DEPARTMENT OF DEFENSE
Title (original language):
Title (English): RELIABILITY PROGRAM REQUIREMENTS FOR SPACE AND LAUNCH VEHICLES*

Organization Abbreviation: DOD
Document #: MIL-STD-1629A NOTICE 2
Date: 1984-11-28
Organization: DOD DEPARTMENT OF DEFENSE
Title (original language):
Title (English): PROCEDURES FOR PERFORMING A FAILURE MODE EFFECTS AND CRITICALITY ANALYSIS*

Organization Abbreviation: DOD
Document #: MIL-STD-1843
Date: 1985-02-08
Organization: DOD DEPARTMENT OF DEFENSE
Title (original language):
Title (English): RELIABILITY-CENTERED MAINTENANCE FOR AIRCRAFT, ENGINES AND EQUIPMENT*

Organization Abbreviation: DOD
Document #: MIL-STD-2067
Date: 1978-10-17
Organization: DOD DEPARTMENT OF DEFENSE
Title (original language):
Title (English): AIRCREW AUTOMATED ESCAPE SYSTEMS RELIABILITY AND MAINTAINABILITY (R/M) PROGRAM REQUIREMENTS FOR*

Organization Abbreviation: DOD
Document #: MIL-STD-2084 VALID NOTICE 2
Date: 1991-07-12
Organization: DOD DEPARTMENT OF DEFENSE
Title (original language):
Title (English): MAINTAINABILITY OF AVIONIC AND ELECTRONIC SYSTEMS AND EQUIPMENT, GENERAL REQUIREMENTS FOR*

Organization Abbreviation: DOD
Document #: MIL-STD-2093 VALID NOTICE 1
Date: 1991-10-02
Organization: DOD DEPARTMENT OF DEFENSE
Title (original language):
Title (English): RELIABILITY PROCEDURES FOR PRODUCTION OF GUIDANCE & CONTROL SECTION FOR GUIDED MISSILE AIM/RIM/7M*

Organization Abbreviation: DOD
Document #: MIL-STD-2155
Date: 1985-07-24
Organization: DOD DEPARTMENT OF DEFENSE
Title (original language):
Title (English): FAILURE REPORTING, ANALYSIS AND CORRECTIVE ACTION SYSTEM*

Organization Abbreviation: DOD
Document #: MIL-STD-2173 NOTICE 1
Date: 1989-12-31
Organization: DOD DEPARTMENT OF DEFENSE
Title (original language):
Title (English): RELIABILITY-CENTERED MAINTENANCE REQUIREMENTS FOR NAVAL AIRCRAFT, WEAPONS SYSTEMS AND SUPPORT EQUIPMENT*

Organization Abbreviation: DOD
Document #: MIL-STD-2218
Date: 1992-05-20
Organization: DOD DEPARTMENT OF DEFENSE
Title (original language):
Title (English): THERMAL DESIGN, ANALYSIS, AND TEST PROCEDURES FOR AIRBORNE ELECTRONIC EQUIPMENT

Organization Abbreviation: DOD
Document #: MIL-HDBK-189
Date: 1981-02-13
Organization: DOD DEPARTMENT OF DEFENSE
Title (original language):
Title (English): RELIABILITY GROWTH MANAGEMENT*

Organization Abbreviation: DOD
Document #: MIL-HDBK-217F CHG NOTICE 1
Date: 1992-07-10
Organization: DOD DEPARTMENT OF DEFENSE
Title (original language):
Title (English): RELIABILITY PREDICTION OF ELECTRONIC EQUIPMENT*

Organization Abbreviation: DOD Document #: MIL-HDBK-251 Date: 1978-01-19
Organization: DOD DEPARTMENT OF DEFENSE
Title (original language):
Title (English): RELIABILITY/DESIGN THERMAL APPLICATIONS*

Organization Abbreviation: DOD Document #: MIL-HDBK-338 VOL II Date: 1984-10-15
Organization: DOD DEPARTMENT OF DEFENSE
Title (original language):
Title (English): ELECTRONIC RELIABILITY DESIGN HANDBOOK*

Organization Abbreviation: DOD Document #: MIL-HDBK-338 -1A VOL I Date: 1988-10-12
Organization: DOD DEPARTMENT OF DEFENSE
Title (original language):
Title (English): ELECTRONIC RELIABILITY DESIGN HANDBOOK*

Organization Abbreviation: DOD Document #: MIL-HDBK-472 NOTICE 1 Date: 1984-01-12
Organization: DOD DEPARTMENT OF DEFENSE
Title (original language):
Title (English): MAINTAINABILITY PREDICTION*

Organization Abbreviation: DOD Document #: MIL-HDBK-781 Date: 1987-07-14
Organization: DOD DEPARTMENT OF DEFENSE
Title (original language):
Title (English): RELIABILITY TEST METHODS, PLANS, AND ENVIRONMENTS FOR ENGINEERING DEVELOPMENT, QUALIFICATION, AND PRODUCTION*

Organization Abbreviation: DOD Document #: DOD-HDBK-791 Date: 1988-03-17
Organization: DOD DEPARTMENT OF DEFENSE
Title (original language):
Title (English): MAINTAINABILITY DESIGN TECHNIQUES METRIC*

Organization Abbreviation: DOD Document #: MIL-HDBK-978B VOL 1 Date: 1988-03-01
Organization: DOD DEPARTMENT OF DEFENSE
Title (original language):
Title (English): NASA PARTS APPLICATION HANDBOOK (VOLUME 1 OF 5) GENERAL INTRODUCTION, CAPACITORS, RESISTORS, THERMISTORS

Organization Abbreviation: DOD Document #: MIL-HDBK-H108 Date: 1960-04-29
Organization: DOD DEPARTMENT OF DEFENSE
Title (original language):
Title (English): SAMPLING PROCEDURES AND TABLES FOR LIFE AND RELIABILITY TESTING (BASED ON EXPONENTIAL DISTRIBUTION)

Organization Abbreviation: EIA Document #: RB4-A Date: 1969-00-00
Organization: EIA ELECTRONIC INDUSTRIES ASSOCIATION (EIA)
Title (original language):
Title (English): RELIABILITY QUANTIFICATION

Organization Abbreviation: EIA Document #: RB9 Date: 1971-00-00
Organization: EIA ELECTRONIC INDUSTRIES ASSOCIATION (EIA)
Title (original language):
Title (English): FAILURE MODE AND EFFECT ANALYSES

Organization Abbreviation: EIA Document #: JESD29-A Date: 1995-00-00
Organization: EIA ELECTRONIC INDUSTRIES ASSOCIATION (EIA)
Title (original language):
Title (English): FAILURE-MECHANISM-DRIVEN RELIABILITY MONITORING

Organization Abbreviation: ETSI Document #: PRI-ETS 300 416 Date: 1994-00-00
Organization: ETSI EUROPEAN TELECOMMUNICATIONS STANDARDS INSTITUTE (ETSI)
Title (original language):
Title (English): TRANSMISSION AND MULTIPLEXING (TM); AVAILABILITY PERFORMANCE OF PATH ELEMENTS OF INTERNATIONAL DIGITAL PATHS

Organization Abbreviation: ETSI Document #: PRI-ETS 300 416 Date: 1995-00-00
Organization: ETSI EUROPEAN TELECOMMUNICATIONS STANDARDS INSTITUTE (ETSI)
Title (original language):
Title (English): TRANSMISSION AND MULTIPLEXING (TM); AVAILABILITY PERFORMANCE OF PATH ELEMENTS OF INTERNATIONAL DIGITAL PATHS

Organization Abbreviation: EURO Document #: EC/EEPSG/73/ 1944 Date: 1972-00-00
Organization: EURO INCLUDES DOCS FROM MORE THAN ONE BODY. CALL GLOBAL OR TI TO ORDER
Title (original language):
Title (English): STANDARD FORMAT FOR PRESENTATION OF RELIABILITY AND MAINTAINABILITY INFORMATION FOR EQUIPMENT SUPPLIERS TO PRIME CONSTRUCTORS

Organization Abbreviation: EURO Document #: DEC/77/7461 Date: 1979-00-00
Organization: EURO INCLUDES DOCS FROM MORE THAN ONE BODY. CALL GLOBAL OR TI TO ORDER
Title (original language):
Title (English): RELIABILITY MILITARY DATA EXCHANGE GUIDE (SUPERSEDED BY DEC/81/ 11953 ISSUE 2)

Organization Abbreviation: EURO Document #: DEC/81/11953 Date: 1981-00-00
Organization: EURO INCLUDES DOCS FROM MORE THAN ONE BODY. CALL GLOBAL OR TI TO ORDER
Title (original language):
Title (English): RELIABILITY MILITARY DATA EXCHANGE GUIDE

Organization Abbreviation: EURO Document #: DEC/81/11953 Date: 1982-00-00
Organization: EURO INCLUDES DOCS FROM MORE THAN ONE BODY. CALL GLOBAL OR TI TO ORDER
Title (original language):
Title (English): RELIABILITY MILITARY DATA EXCHANGE GUIDE (2ND EDITION)

Organization Abbreviation: EURO Document #: PSC/83/12418 Date: 1983-00-00
Organization: EURO INCLUDES DOCS FROM MORE THAN ONE BODY. CALL GLOBAL OR TI TO ORDER
Title (original language):
Title (English): SUPPLY OF BASIC MAINTAINABLITY AND RELIABILITY DATA

Organization Abbreviation: IEC Document #: 409 Date: 1981-00-00
Organization: IEC INTERNATIONAL ELECTROTECHNICAL COMMISSION (IEC)
Title (original language):
Title (English): GUIDE FOR THE INCLUSION OF RELIABILITY CLAUSES INTO SPECIFICATIONS FOR COMPONENTS (OR PARTS) FOR ELECTRONIC EQUIPMENT SECOND EDITION

Organization Abbreviation: IEC Document #: 571 PT 3 Date: 1990-00-00
Organization: IEC INTERNATIONAL ELECTROTECHNICAL COMMISSION (IEC)
Title (original language):
Title (English): ELECTRONIC EQUIPMENT USED ON RAIL VEHICLES PART 3: COMPONENTS, PROGRAMMABLE ELECTRONIC EQUIPMENT AND ELECTRONIC SYSTEM RELIABILITY FIRST EDITION

Organization Abbreviation: IEEE Document #: 500 P&V Date: 1984-00-00
Organization: IEEE INSTITUTE OF ELECTRICAL & ELECTRONICS ENGINEERS (IEEE)
Title (original language):
Title (English): STANDARD RELIABILITY DATA FOR PUMPS AND DRIVERS, VALVE ACTUATORS, AND VALVES

Organization Abbreviation: IES. Document #: Date:
Organization: IES. INSTITUTE OF ENVIRONMENTAL SCIENCES (I.E.S.)
Title (original language):
Title (English): GLOSSARY OF RELIABILITY GROWTH TERMS

Organization Abbreviation: IESNA Document #: RP-21 Date: 1984-00-00
Organization: IESNA ILLUMINATING ENGINEERING SOCIETY OF NORTH AMERICA (IESNA)
Title (original language):
Title (English): CALCULATION OF DAYLIGHT AVAILABILITY (R 1991)

Organization Abbreviation: IPC Document #: SM-785 Date: 1992-00-00
Organization: IPC INSTITUTE FOR INTERCONNECTING AND PACKAGING ELECTRONIC CIRCUITS (IPC)
Title (original language):
Title (English): GUIDELINES FOR ACCELERATED RELIABILITY TESTING OF SURFACE MOUNT SOLDER ATTACHMENTS

Organization Abbreviation: IPC Document #: TR-579 Date: 1988-00-00
Organization: IPC INSTITUTE FOR INTERCONNECTING AND PACKAGING ELECTRONIC CIRCUITS (IPC)
Title (original language):
Title (English): ROUND ROBIN RELIABILITY EVALUATION OF SMALL DIAMETER PLATED THROUGH HOLES IN PRINTED WIRING BOARDS

Organization Abbreviation: IPC Document #: AJ-820 2.5.1 Date: 1978-00-00
Organization: IPC INSTITUTE FOR INTERCONNECTING AND PACKAGING ELECTRONIC CIRCUITS (IPC)
Title (original language):
Title (English): INTERRELATIONSHIP OF CLEANLINESS, SOLDERABILITY AND RELIABILITY (ASSEMBLY-JOINING HANDBOOK)

Organization Abbreviation: IPC Document #: AJ-820 8.4.1 Date: 1978-00-00
Organization: IPC INSTITUTE FOR INTERCONNECTING AND PACKAGING ELECTRONIC CIRCUITS (IPC)
Title (original language):
Title (English): INCREASE RELIABILITY-REDUCE SOLDER JOINT FAILURE (ASSEMBLY-JOINING HANDBOOK)

Organization Abbreviation: IPC Document #: TA-723 SECTION 8 Date:
Organization: IPC INSTITUTE FOR INTERCONNECTING AND PACKAGING ELECTRONIC CIRCUITS (IPC)
Title (original language):
Title (English): RELIABILITY

Organization Abbreviation: ISO Document #: 2382 SEC XIV Date: 1978-00-00
Organization: ISO INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)
Title (original language):
Title (English): DATA PROCESSING - VOCABULARY - SECTION 14: RELIABILITY, MAINTENANCE AND AVAILABILITY FIRST EDITION

Organization Abbreviation: ISO Document #: 2394 Date: 1986-00-00
Organization: ISO INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)
Title (original language):
Title (English): GENERAL PRINCIPLES ON RELIABILITY FOR STRUCTURES SECOND EDITION; (ADDENDUM 1-1988)

Organization Abbreviation: ISO Document #: 5843 PT 8 Date: 1988-00-00
Organization: ISO INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)
Title (original language):
Title (English): AEROSPACE - LIST OF EQUIVALENT TERMS - PART 8: AIRCRAFT RELIABILITY FIRST EDITION

Organization Abbreviation: ISO Document #: 6527 Date: 1982-00-00
Organization: ISO INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)
Title (original language):
Title (English): NUCLEAR POWER PLANTS - RELIABILITY DATA EXCHANGE - GENERAL GUIDELINES FIRST EDITION

Organization Abbreviation: ISO Document #: 7385 Date: 1983-00-00
Organization: ISO INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)
Title (original language):
Title (English): NUCLEAR POWER PLANTS - GUIDELINES TO ENSURE QUALITY OF COLLECTED DATA ON RELIABILITY FIRST EDITION

Organization Abbreviation: ISO Document #: 8107 Date: 1993-00-00
Organization: ISO INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)
Title (original language):
Title (English): NUCLEAR POWER PLANTS - MAINTAINABILITY - TERMINOLOGY FIRST EDITION

Organization Abbreviation: ISO Document #: 8927 Date: 1991-00-00
Organization: ISO INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)
Title (original language):
Title (English): EARTH-MOVING MACHINERY - MACHINE AVAILABILITY - VOCABULARY FIRST EDITION

Organization Abbreviation: ISO Document #: 8930 Date: 1987-00-00
Organization: ISO INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)
Title (original language):
Title (English): GENERAL PRINCIPLES ON RELIABILITY FOR STRUCTURES - LIST OF EQUIVALENT TERMS FIRST EDITION

Organization Abbreviation: JIS Document #: C 5700 Date: 1974-00-00
Organization: JIS JAPANESE INDUSTRIAL STANDARDS (JIS)
Title (original language):
Title (English): GENERAL RULES FOR RELIABILITY ASSURED ELECTRONIC COMPONENTS (R 1982)

Organization Abbreviation: JIS Document #: X 0014 Date: 1987-00-00
Organization: JIS JAPANESE INDUSTRIAL STANDARDS (JIS)
Title (original language):
Title (English): GLOSSARY OF TERMS USED IN INFORMATION PROCESSING (RELIABILITY, MAINTENANCE AND AVAILABILITY)

Organization Abbreviation: JIS Document #: Z 8115 Date: 1981-00-00
Organization: JIS JAPANESE INDUSTRIAL STANDARDS (JIS)
Title (original language):
Title (English): GLOSSARY OF TERMS USED IN RELIABILITY

Organization Abbreviation: JTC1 Document #: 2382 SEC XIV Date: 1978-00-00
Organization: JTC1 JOINT TECHNICAL COMMITTEE(ISO/IEC JTC1)
Title (original language):
Title (English): DATA PROCESSING - VOCABULARY - SECTION 14: RELIABILITY, MAINTENANCE AND AVAILABILITY FIRST EDITION

Organization Abbreviation: NFPA Document #: FPEH SEC 4-5 Date:
Organization: NFPA NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)
Title (original language):
Title (English): RELIABILITY (SFPE HANDBOOK OF FIRE PROTECTION ENGINEERING)

Organization Abbreviation: RAC Document #: CRTA-FMECA Date: 1993-00-00
Organization: RAC RELIABILITY ANALYSIS CENTER RL/RAC
Title (original language):
Title (English): FAILURE MODE, EFFECTS, AND CRITICALITY ANALYSIS (FMECA)

Organization Abbreviation: RAC Document #: CRTA-PEM Date: 1992-00-00
Organization: RAC RELIABILITY ANALYSIS CENTER RL/RAC
Title (original language):
Title (English): PLASTIC MICROCIRCUIT PACKAGES: A TECHNOLOGY REVIEW

Organization Abbreviation: RAC Document #: EEMD-1 Date: 1980-00-00
Organization: RAC RELIABILITY ANALYSIS CENTER RL/RAC
Title (original language):
Title (English): ELECTRONIC EQUIPMENT MAINTAINABILITY DATA

Organization Abbreviation: RAC Document #: EERD-2 Date: 1986-00-00
Organization: RAC RELIABILITY ANALYSIS CENTER RL/RAC
Title (original language):
Title (English): ELECTRONIC EQUIPMENT RELIABILITY DATA

Organization Abbreviation: RAC Document #: FTA Date: 1990-00-00
Organization: RAC RELIABILITY ANALYSIS CENTER RL/RAC
Title (original language):
Title (English): FAULT TREE ANALYSIS APPLICATION GUIDE

Organization Abbreviation: RAC Document #: NONOP-1 Date: 1987-00-00
Organization: RAC RELIABILITY ANALYSIS CENTER RL/RAC
Title (original language):
Title (English): NONOPERATING RELIABILITY DATABOOK

Organization Abbreviation: RAC Document #: NPRD Date: 1991-00-00
Organization: RAC RELIABILITY ANALYSIS CENTER RL/RAC
Title (original language):
Title (English): NONELECTRONIC PARTS RELIABILITY DATA

Organization Abbreviation: RAC Document #: NPS Date: 1993-00-00
Organization: RAC RELIABILITY ANALYSIS CENTER RL/RAC
Title (original language):
Title (English): MECHANICAL APPLICATIONS IN RELIABILITY ENGINEERING

Organization Abbreviation: RAC Document #: NPS-1 Date: 1985-00-00
Organization: RAC RELIABILITY ANALYSIS CENTER RL/RAC
Title (original language):
Title (English): ANALYSIS TECHNIQUES FOR MECHANICAL RELIABILITY

Organization Abbreviation: RAC Document #: RDSC-1 Date: 1990-00-00
Organization: RAC RELIABILITY ANALYSIS CENTER RL/RAC
Title (original language):
Title (English): RELIABILITY SOURCEBOOK

Organization Abbreviation: RAC Document #: RMST-93 Date: 1993-00-00
Organization: RAC RELIABILITY ANALYSIS CENTER RL/RAC
Title (original language):
Title (English): RELIABILITY & MAINTAINABILITY SOFTWARE TOOLS

Organization Abbreviation: RAC Document #: PRIM Date: 1992-00-00
Organization: RAC RELIABILITY ANALYSIS CENTER RL/RAC
Title (original language):
Title (English): PRIMER FOR DOD RELIABILITY, MAINTAINABILITY, SAFETY, AND LOGISTICS STANDARDS

Organization Abbreviation: RAC Document #: PRIM SEC 1 Date: 1992-00-00
Organization: RAC RELIABILITY ANALYSIS CENTER RL/RAC
Title (original language):
Title (English): INTRODUCTION (STEEL PRODUCTS MANUAL)

Organization Abbreviation: RAC Document #: PRIM SEC 2 Date: 1992-00-00
Organization: RAC RELIABILITY ANALYSIS CENTER RL/RAC
Title (original language):
Title (English): RELIABILITY PROGRAM SPECIFICATIONS (STEEL PRODUCTS MANUAL)

Organization Abbreviation: RAC Document #: PRIM SEC 3 Date: 1992-00-00
Organization: RAC RELIABILITY ANALYSIS CENTER RL/RAC
Title (original language):
Title (English): RELIABILITY ASSESSMENT SPECIFICATIONS (STEEL PRODUCTS MANUAL)

Organization Abbreviation: RAC Document #: PRIM SEC 4 Date: 1992-00-00
Organization: RAC RELIABILITY ANALYSIS CENTER RL/RAC
Title (original language):
Title (English): RELIABILITY DESIGN SPECIFICATIONS (STEEL PRODUCTS MANUAL)

Organization Abbreviation: RAC Document #: PRIM SEC 6 Date: 1992-00-00
Organization: RAC RELIABILITY ANALYSIS CENTER RL/RAC
Title (original language):
Title (English): MAINTAINABILITY PROGRAM SPECIFICATION (STEEL PRODUCTS MANUAL)

Organization Abbreviation: RAC Document #: PRIM SEC 7 Date: 1992-00-00
Organization: RAC RELIABILITY ANALYSIS CENTER RL/RAC
Title (original language):
Title (English): MAINTAINABILITY DESIGN SPECIFICATIONS (STEEL PRODUCTS MANUAL)

Organization Abbreviation: RAC Document #: PRIM SEC 8 Date: 1992-00-00
Organization: RAC RELIABILITY ANALYSIS CENTER RL/RAC
Title (original language):
Title (English): MAINTAINABILITY ASSESSMENT SPECIFICATIONS (STEEL PRODUCTS MANUAL)

Organization Abbreviation: RAC Document #: PRIM SEC 10 Date: 1992-00-00
Organization: RAC RELIABILITY ANALYSIS CENTER RL/RAC
Title (original language):
Title (English): LOGISTICS SPECIFICATIONS

Organization Abbreviation: RAC Document #: TOOLKIT Date: 1993-00-00
Organization: RAC RELIABILITY ANALYSIS CENTER RL/RAC
Title (original language):
Title (English): RELIABILITY ENGINEER'S TOOLKIT

Organization Abbreviation: RAC Document #: MFAT-2 Date:
Organization: RAC RELIABILITY ANALYSIS CENTER RL/RAC
Title (original language):
Title (English): CHARACTERIZATION AND FAILURE ANALYSIS TECHNIQUES A

Organization Abbreviation: RAC Document #: MFAT-2 SEC I Date:
Organization: RAC RELIABILITY ANALYSIS CENTER RL/RAC
Title (original language):
Title (English): GENERAL INTRODUCTION

Organization Abbreviation: RAC Document #: MFAT-2 SEC V PT A Date:
Organization: RAC RELIABILITY ANALYSIS CENTER RL/RAC
Title (original language):
TITLE (ENGLISH): CHARACTERIZATION AND FAILURE ANALYSIS TECHNIQUES PART A - RELIABILITY TESTING

Organization Abbreviation: RAC Document #: SOAR-2 Date: 1983-00-00
Organization: RAC RELIABILITY ANALYSIS CENTER RL/RAC
Title (original language):
Title (English): PRACTICAL STATISTICAL ANALYSIS FOR THE RELIABILITY ENGINEER

Organization Abbreviation: RAC Document #: SOAR-3 Date: 1985-00-00
Organization: RAC RELIABILITY ANALYSIS CENTER RL/RAC
Title (original language):
Title (English): IC QUALITY GRADES: IMPACT ON SYSTEM RELIABILITY AND LIFE CYCLE COST

Organization Abbreviation: RAC Document #: SOAR-4 Date: 1985-00-00
Organization: RAC RELIABILITY ANALYSIS CENTER RL/RAC
Title (original language):
Title (English): CONFIDENCE BOUNDS FOR SYSTEM RELIABILITY

Organization Abbreviation: RAC Document #: SOAR-5 Date: 1986-00-00
Organization: RAC RELIABILITY ANALYSIS CENTER RL/RAC
Title (original language):
Title (English): SURFACE MOUNT TECHNOLOGY: A RELIABILITY REVIEW

Organization Abbreviation: RAC Document #: SOAR-6 Date: 1986-00-00
Organization: RAC RELIABILITY ANALYSIS CENTER RL/RAC
Title (original language):
Title (English): ESD CONTROL IN THE MANUFACTURING ENVIRONMENT

Organization Abbreviation: RAC Document #: SOAR-8 Date: 1992-00-00
Organization: RAC RELIABILITY ANALYSIS CENTER RL/RAC
Title (original language):
Title (English): PROCESS ACTION TEAM HANDBOOK

Organization Abbreviation: RTCA Document #: DO-167 Date: 1977-00-00
Organization: RTCA RTCA INC
Title (original language):
Title (English): AIRBORNE ELECTRONICS AND ELECTRICAL EQUIPMENT RELIABILITY

Organization Abbreviation: SAA Document #: AS 1189.14 Date: 1982-00-00
Organization: SAA STANDARDS ASSOCIATION OF AUSTRALIA (SAA)
Title (original language):
Title (English): DATA PROCESSING - VOCABULARY - PART 14: RELIABILITY, MAINTENANCE AND AVAILABILITY

Organization Abbreviation: SAA Document #: AS 2529 Date: 1982-00-00
Organization: SAA STANDARDS ASSOCIATION OF AUSTRALIA (SAA)
Title (original language):
Title (English): COLLECTION OF RELIABILITY, AVAILABILITY AND MAINTAINABILITY DATA FOR ELECTRONICS AND SIMILAR ENGINEERING USE (R 1994)

Organization Abbreviation: SAA Document #: AS 2530 Date: 1982-00-00
Organization: SAA STANDARDS ASSOCIATION OF AUSTRALIA (SAA)
Title (original language):
Title (English): PRESENTATION OF RELIABILITY DATA ON ELECTRONIC AND SIMILAR COMPONENTS (R 1994)

Organization Abbreviation: SAA Document #: AS 3900.4 Date: 1994-00-00
Organization: SAA STANDARDS ASSOCIATION OF AUSTRALIA (SAA)
Title (original language):
Title (English): QUALITY MANAGEMENT AND QUALITY ASSURANCE STANDARDS - PART 4: GUIDELINES TO DEPENDABILITY PROGRAM MANAGEMENT (NZS 9000.4: 1994/ISO 9000-4:1993/IEC 300-1:1993)(IN PROFESSIONAL PACKAGE A 46A)

Organization Abbreviation: SAA Document #: AS 3930 Date: 1992-00-00
Organization: SAA STANDARDS ASSOCIATION OF AUSTRALIA (SAA)
Title (original language):
Title (English): RELIABILITY AND MAINTAINABILITY - INTRODUCTORY GUIDE (IN PROFESSIONAL PACKAGE 46)

Organization Abbreviation: SAA Document #: AS 3960 Date: 1990-00-00
Organization: SAA STANDARDS ASSOCIATION OF AUSTRALIA (SAA)
Title (original language):
Title (English): GUIDE TO RELIABILITY AND MAINTAINABILITY PROGRAM MANAGEMENT

Organization Abbreviation: SAE Document #: ARP 813B Date: 1995-00-00
Organization: SAE SAE INTERNATIONAL
Title (original language):
Title (English): MAINTAINABILITY RECOMMENDATIONS FOR AIRCRAFT WHEEL AND BRAKE DESIGN

Organization Abbreviation: SAE Document #: ARD 50013 Date: 1991-00-00
Organization: SAE SAE INTERNATIONAL
Title (original language):
Title (English): SOLID ROCKET BOOSTER RELIABILITY GUIDEBOOK

Organization Abbreviation: SAE   Document #: J 1032   Date: 1987-00-00
Organization: SAE SAE INTERNATIONAL
Title (original language):
Title (English): DEFINITIONS FOR MACHINE AVAILABILITY (OFF-ROAD WORK MACHINES), RECOMMENDED PRACTICE; APRIL 1987

Organization Abbreviation: SEMI   Document #: E10   Date: 1992-00-00
Organization: SEMI SEMICONDUCTOR EQUIPMENT AND MATERIALS INTERNATIONAL (SEMI)
Title (original language):
Title (English): GUIDELINE FOR DEFINITION AND MEASUREMENT OF EQUIPMENT RELIABILITY, AVAILABILITY, AND MAINTAINABILITY (RAM)

Organization Abbreviation: VDI   Document #: VDI/VDE 2180 Blatt 2   Date: 1986-04-00
Organization: VDI VEREIN DEUTSCHER INGENIEURE (VDI)
Title (original language): SICHERUNG VON ANLAGEN DER VERFAHRENSTECHNIK MIT MITTELN DER MESS-, STEUERUNGS- UND REGELUNGSTECHNIK; BERECHNUNGSMETHODEN FUER ZUVERLAESSIGKEITSKENNGROESSEN VON SICHERUNGSEINRICHTUNGEN
Title (English): SAFEGUARDING OF INDUSTRIAL PROCESSING PLANTS BY MEANS OF INSTRUMENTATION AND CONTROL TECHNOLOGY; CALCULATING METHODS FOR RELIABILITY CHARACTERISTICS OF SAFETY FACILITIES

Organization Abbreviation: VDI   Document #: VDI/VDE 3540 Blatt 1   Date: 1975-08-00
Organization: VDI VEREIN DEUTSCHER INGENIEURE (VDI)
Title (original language): ZUVERLAESSIGKEIT VON MESS-, STEUER- UND REGELGERAETEN; ERFASSUNG VON AUSFALLDATEN
Title (English): RELIABILITY OF MEASURING AND CONTROL EQUIPMENT

Organization Abbreviation: VDI   Document #: VDI/VDE 3540 Blatt 2   Date: 1975-12-00
Organization: VDI VEREIN DEUTSCHER INGENIEURE (VDI)
Title (original language): ZUVERLAESSIGKEIT VON MESS-, STEUER- UND REGELGERAETEN; KLIMAKLASSEN FUER GERAETE UND ZUBEHOER
Title (English): RELIABILITY OF MEASURING AND CONTROL EQUIPMENT; CLASSIFICATION OF CLIMATES

Organization Abbreviation: VDI   Document #: VDI/VDE 3540 Blatt 3   Date: 1982-03-00
Organization: VDI VEREIN DEUTSCHER INGENIEURE (VDI)
Title (original language): ZUVERLAESSIGKEIT VON MESS-, STEUER- UND REGELGERAETEN; VEREINFACHTE ERMITTLUNG VON AUSFALLRATEN
Title (English): RELIABILITY OF MEASURING AND CONTROL EQUIPMENT; SIMPLIFIED DETERMINATION OF FAILURE RATES

Organization Abbreviation: VDI   Document #: VDI/VDE 3542 Blatt 4   Date: 1993-07-00
Organization: VDI VEREIN DEUTSCHER INGENIEURE (VDI)
Title (original language): SICHERHEITSTECHNISCHE BEGRIFFE FUER AUTOMATISIERUNGSSYSTEME; ZUVERLAESSIGKEIT UND SICHERHEIT KOMPLEXER SYSTEME (BEGRIFFE)
Title (English): SAFETY TERMS FOR AUTOMATION SYSTEMS; RELIABILITY AND SAFETY OF COMPLEX SYSTEMS (TERMS)

Organization Abbreviation: VDI   Document #: VDI/VDE 3558   Date: 1981-03-00
Organization: VDI VEREIN DEUTSCHER INGENIEURE (VDI)
Title (original language): PROJEKTIERUNG VON PROZESSRECHNERSYSTEMEN MIT EINFACHER REDUNDANZ ZUR ERHOEHUNG DER VERFUEGBARKEIT EINER AUTOMATISIERUNGSANLAGE
Title (English): DESIGN OF PROCESS COMPUTER SYSTEMS WITH REDUNDANCY FOR INCREASED AVAILABILITY OF AN AUTOMATED PROCESS

Organization Abbreviation: VDI   Document #: VDI 3581   Date: 1983-04-00
Organization: VDI VEREIN DEUTSCHER INGENIEURE (VDI)
Title (original language): ZUVERLAESSIGKEIT UND VERFUEGBARKEIT VON TRANSPORT- UND LAGERANLAGEN
Title (English): RELIABILITY AND AVAILABILITY OF INSTALLATIONS FOR TRANSPORTATION AND STORAGE

Organization Abbreviation: VDI   Document #: VDI 3649   Date: 1992-01-00
Organization: VDI VEREIN DEUTSCHER INGENIEURE (VDI)
Title (original language): ANWENDUNG DER VERFUEGBARKEITSRECHNUNG FUER FOERDER- UND LAGERSYSTEME
Title (English): CALCULATION OF AVAILABILITY IN HANDLING AND STORAGE SYSTEMS

Organization Abbreviation: VDI   Document #: VDI/VDE 3691   Date: 1985-05-00
Organization: VDI VEREIN DEUTSCHER INGENIEURE (VDI)
Title (original language): ERFASSUNG VON ZUVERLAESSIGKEITSWERTEN BEI PROZESSRECHNEREINSAETZEN
Title (English): RECORDING OF RELIABILITY CHARACTERISTICS BY PROCESS COMPUTER APPLICATIONS

Organization Abbreviation: VDI   Document #: VDI 4001 Blatt 1   Date: 1985-10-00
Organization: VDI VEREIN DEUTSCHER INGENIEURE (VDI)
Title (original language): ALLGEMEINE HINWEISE ZUM VDI-HANDBUCH TECHNISCHE ZUVERLAESSIGKEIT
Title (English): GENERAL GUIDE TO THE VDI-HANDBOOK RELIABILITY ENGINEERING

Organization Abbreviation: VDI   Document #: VDI 4001 Blatt 2   Date: 1986-06-00
Organization: VDI VEREIN DEUTSCHER INGENIEURE (VDI)
Title (original language): BEGRIFFSBESTIMMUNGEN ZUM GEBRAUCH DES VDI-HANDBUCHES; TECHNISCHE ZUVERLAESSIGKEIT
Title (English): BASIC TERMS AND DEFINITIONS

Organization Abbreviation: VDI   Document #: VDI 4002 Blatt 1   Date: 1986-07-00
Organization: VDI VEREIN DEUTSCHER INGENIEURE (VDI)
Title (original language): SYSTEMATISCHE GRUNDLAGEN; ERLAEUTERUNGEN ZUM PROBLEM DER ZUVERLAESSIGKEIT TECHNISCHER ERZEUGNISSE UND/ODER SYSTEME
Title (English): SYSTEMS ENGINEERING CONSIDERATIONS; INTRODUCTION INTO THE RELIABILITY PROBLEM OF TECHNICAL PRODUCTS AND/OR SYSTEMS

Organization Abbreviation: VDI Document #: VDI 4003 Blatt 1 Date: 1985-12-00
Organization: VDI VEREIN DEUTSCHER INGENIEURE (VDI)
Title (original language): ANWENDUNG ZUVERLAESSIGKEITSBEZOGENER PROGRAMME
Title (English): APPLICATION OF RELIABILITY RELATED PROGRAMMES

Organization Abbreviation: VDI Document #: VDI 4003 Blatt 2 Date: 1986-05-00
Organization: VDI VEREIN DEUTSCHER INGENIEURE (VDI)
Title (original language): ALLGEMEINE FORDERUNGEN AN EIN SICHERUNGSPROGRAMM, KLASSE A; FUNKTIONSZUVERLAESSIGKEIT
Title (English): GENERAL REQUIREMENTS FOR AN ASSURANCE PROGRAMME, CLASS A; FUNCTIONAL RELIABILITY

Organization Abbreviation: VDI Document #: VDI 4003 Blatt 3 Date: 1983-05-00
Organization: VDI VEREIN DEUTSCHER INGENIEURE (VDI)
Title (original language): ALLGEMEINE FORDERUNGEN AN EIN SICHERUNGSPROGRAMM, KLASSE A; INSTANDHALTBARKEIT
Title (English): GENERAL REQUIREMENTS FOR AN ASSURANCE PROGRAMME; CLASS A - MAINTAINABILITY

Organization Abbreviation: VDI Document #: VDI 4003 Blatt 5 Date: 1985-10-00
Organization: VDI VEREIN DEUTSCHER INGENIEURE (VDI)
Title (original language): ALLGEMEINE FORDERUNGEN AN EIN SICHERUNGSPROGRAMM, KLASSE A; VERFUEGBARKEIT
Title (English): GENERAL REQUIREMENTS FOR AN ASSURANCE PROGRAMME, CLASS A; AVAILABILITY

Organization Abbreviation: VDI Document #: VDI 4004 Blatt 1 Date: 1986-09-00
Organization: VDI VEREIN DEUTSCHER INGENIEURE (VDI)
Title (original language): ZUVERLAESSIGKEITSKENNGROESSEN; UEBERSICHT
Title (English): RELIABILITY ATTRIBUTES; SURVEY

Organization Abbreviation: VDI Document #: VDI 4004 Blatt 2 Date: 1986-08-00
Organization: VDI VEREIN DEUTSCHER INGENIEURE (VDI)
Title (original language): ZUVERLAESSIGKEITSKENNGROESSEN; UEBERLEBENSKENNGROESSEN
Title (English): RELIABILITY CHARACTERISTICS; SURVIVAL CHARACTERISTICS

Organization Abbreviation: VDI Document #: VDI 4004 Blatt 3 Date: 1986-09-00
Organization: VDI VEREIN DEUTSCHER INGENIEURE (VDI)
Title (original language): KENNGROESSEN DER INSTANDHALTBARKEIT
Title (English): ATTRIBUTES OF MAINTAINABILITY

Organization Abbreviation: VDI Document #: VDI 4004 Blatt 4 Date: 1986-07-00
Organization: VDI VEREIN DEUTSCHER INGENIEURE (VDI)
Title (original language): ZUVERLAESSIGKEITSKENNGROESSEN; VERFUEGBARKEITSKENNGROESSEN
Title (English): RELIABILITY CHARACTERISTICS; AVAILABILITY CHARACTERISTICS

Organization Abbreviation: VDI Document #: VDI 4005 Blatt 1 Date: 1981-08-00
Organization: VDI VEREIN DEUTSCHER INGENIEURE (VDI)
Title (original language): EINFLUESSE VON UMWELTBEDINGUNGEN AUF DIE ZUVERLAESSIGKEIT TECHNISCHER ERZEUGNISSE; GRUNDLAGEN
Title (English): INFLUENCES OF ENVIRONMENTAL CONDITIONS ON REABILITY OF TECHNICAL PRODUCTS; FUNDAMENTAL CONSIDERATIONS

Organization Abbreviation: VDI Document #: VDI 4005 Blatt 2 Date: 1983-11-00
Organization: VDI VEREIN DEUTSCHER INGENIEURE (VDI)
Title (original language): EINFLUESSE VON UMWELTBEDINGUNGEN AUF DIE ZUVERLAESSIGKEIT TECHNISCHER ERZEUGNISSE; MECHANISCHE EINFLUESSE DER UMWELT
Title (English): INFLUENCES OF ENVIRONMENTAL CONDITIONS ON RELIABILITY OF TECHNICAL PRODUCTS; MECHANICAL INFLUENCES OF ENVIRONMENTAL FACTORS

Organization Abbreviation: VDI Document #: VDI 4005 Blatt 3 Date: 1983-11-00
Organization: VDI VEREIN DEUTSCHER INGENIEURE (VDI)
Title (original language): EINFLUESSE VON UMWELTBEDINGUNGEN AUF DIE ZUVERLAESSIGKEIT TECHNISCHER ERZEUGNISSE; THERMISCH-KLIMATISCHE EINFLUESSE DER UMWELT
Title (English): INFLUENCES OF ENVIRONMENTAL CONDITIONS ON RELIABILITY OF TECHNICAL PRODUCTS; THERMAL AND CLIMATIC INFLUENCES OF ENVIRONMENTAL FACTORS

Organization Abbreviation: VDI Document #: VDI 4005 Blatt 4 Date: 1983-11-00
Organization: VDI VEREIN DEUTSCHER INGENIEURE (VDI)
Title (original language): EINFLUESSE VON UMWELTBEDINGUNGEN AUF DIE ZUVERLAESSIGKEIT TECHNISCHER ERZEUGNISSE; CHEMISCH-BIOLOGISCHE EINFLUESSE DER UMWELT
Title (English): INFLUENCES OF ENVIRONMENTAL CONDITIONS ON RELIABILITY OF TECHNICAL PRODUCTS; CHEMICAL AND BIOLOGICAL INFLUENCES OF ENVIRONMENTAL FACTORS

Organization Abbreviation: VDI Document #: VDI 4005 Blatt 5 Date: 1983-11-00
Organization: VDI VEREIN DEUTSCHER INGENIEURE (VDI)
Title (original language): EINFLUESSE VON UMWELTBEDINGUNGEN AUF DIE ZUVERLAESSIGKEIT TECHNISCHER ERZEUGNISSE; ELEKTROMAGNETISCHE EINFLUESSE DER UMWELT
Title (English): INFLUENCES OF ENVIRONMENTAL CONDITIONS ON RELIABILITY OF TECHNICAL PRODUCTS; ELECTROMAGNETIC INFLUENCES OF ENVIRONMENTAL FACTORS

Organization Abbreviation: VDI Document #: VDI 4007 Blatt 1 Date: 1986-09-00
Organization: VDI VEREIN DEUTSCHER INGENIEURE (VDI)
Title (original language): ZUVERLAESSIGKEITSMANAGEMENT; UEBERSICHT
Title (English): RELIABILITY MANAGEMENT; SURVEY
Organization Abbreviation: VDI Document #: VDI 4007 Blatt 2 Date: 1981-01-00
Organization: VDI VEREIN DEUTSCHER INGENIEURE (VDI)
Title (original language): ORGANISATION UND ZUSAMMENARBEIT DER ZUVERLAESSIGKEITSSICHERUNGSSTELLEN VON DER PLANUNG BIS ZUR ERSTELLUNG DES SYSTEMS/PRODUKTS

Title (English): RELIABILITY ASSURANCE ORGANISATION; STRUCTURE AND COOPERATION; FROM THE PLANNING TO THE REALISATION OF A SYSTEM/PRODUCT AT CUSTOMER, CONTRACTOR AND INDEPENDENT SUPERVISING ORGANISATIONS

Organization Abbreviation: VDI Document #: VDI 4007 Blatt 3 Date: 1991-04-00
Organization: VDI VEREIN DEUTSCHER INGENIEURE (VDI)
Title (original language): ZUVERLAESSIGKEITSMANAGEMENT IN DER VERWENDUNGSPHASE; VORAUSSETZUNGEN, BETEILIGTE STELLEN UND DEREN FUNKTIONEN, ZUSAMMENARBEIT UND ORGANISATION
Title (English): RELIABILITY MANAGEMENT DURING THE PHASE OF APPLICATION; PREREQUISITES, AGENCIES AND DEPARTMENTS INVOLVED AND THEIR FUNCTIONS, CO-OPERATION AND ORGANIZATION

Organization Abbreviation: VDI Document #: VDI 4007 Blatt 4 Date: 1980-07-00
Organization: VDI VEREIN DEUTSCHER INGENIEURE (VDI)
Title (original language): BERICHTSWESEN IN DER ZUVERLAESSIGKEIT
Title (English): PROJECT RELIABILITY DOCUMENTATION (REQUIREMENTS, INFORMATION, REPORTS)

Organization Abbreviation: VDI Document #: VDI 4008 Blatt 1 Date: 1986-05-00
Organization: VDI VEREIN DEUTSCHER INGENIEURE (VDI)
Title (original language): VORAUSSETZUNGEN UND ANWENDUNGSSCHWERPUNKTE VON ZUVERLAESSIGKEITSANALYSEN
Title (English): CONDITIONS AND APPLICATIONAL PREFERENCES OF RELIABILITY ANALYSES

Organization Abbreviation: VDI Document #: VDI 4008 Blatt 2 Date: 1986-04-00
Organization: VDI VEREIN DEUTSCHER INGENIEURE (VDI)
Title (original language): BOOLESCHES MODELL
Title (English): BOOLEAN MODEL

Organization Abbreviation: VDI Document #: VDI 4008 Blatt 3 Date: 1986-08-00
Organization: VDI VEREIN DEUTSCHER INGENIEURE (VDI)
Title (original language): MARKOFF-ZUSTANDSAENDERUNGSMODELLE MIT ENDLICH VIELEN ZUSTAENDEN
Title (English): MARKOVIAN STATE MODELS WITH A FINITE NUMBER OF STATES

Organization Abbreviation: VDI Document #: VDI 4008 Blatt 5 Date: 1986-07-00
Organization: VDI VEREIN DEUTSCHER INGENIEURE (VDI)
Title (original language): ZUSTANDSFLUSSGRAPHEN
Title (English): STATE FLOW GRAPHS

Organization Abbreviation: VDI Document #: VDI 4008 Blatt 6 Date: 1985-12-00
Organization: VDI VEREIN DEUTSCHER INGENIEURE (VDI)
Title (original language): MONTE-CARLO-SIMULATION
Title (English): MONTE-CARLO-SIMULATION

Organization Abbreviation: VDI Document #: VDI 4008 Blatt 7 Date: 1986-05-00
Organization: VDI VEREIN DEUTSCHER INGENIEURE (VDI)
Title (original language): STRUKTURFUNKTION UND IHRE ANWENDUNG
Title (English): STRUCTURE FUNCTION AND ITS APPLICATIONS

Organization Abbreviation: VDI Document #: VDI 4008 Blatt 8 Date: 1984-03-00
Organization: VDI VEREIN DEUTSCHER INGENIEURE (VDI)
Title (original language): ERNEUERUNGSPROZESSE
Title (English): RENEWAL PROCESSES

Organization Abbreviation: VDI Document #: VDI 4008 Blatt 9 Date: 1986-04-00
Organization: VDI VEREIN DEUTSCHER INGENIEURE (VDI)
Title (original language): MATHEMATISCHE MODELLE FUER REDUNDANZ
Title (English): MATHEMATICAL MODELS OF REDUNDANCY

Organization Abbreviation: VDI Document #: VDI 4009 Blatt 1 Date: 1986-07-00
Organization: VDI VEREIN DEUTSCHER INGENIEURE (VDI)
Title (original language): UEBERBLICK UEBER ZUVERLAESSIGKEITS-TESTS
Title (English): SURVEY ON RELIABILITY TESTS

Organization Abbreviation: VDI Document #: VDI 4009 Blatt 2 Date: 1984-08-00
Organization: VDI VEREIN DEUTSCHER INGENIEURE (VDI)
Title (original language): PRUEFVERTEILUNGEN UND IHRE ANWENDUNGEN AUF VERTRAUENBEREICHE UND STATISTISCHE TESTS
Title (English): TEST DISTRIBUTIONS AND THEIR APPLICATIONS TO CONFIDENCE INTERVALS AND STATISTICAL TESTS

Organization Abbreviation: VDI Document #: VDI 4009 Blatt 3 Date: 1984-07-00
Organization: VDI VEREIN DEUTSCHER INGENIEURE (VDI)
Title (original language): QUALITAETSREGELKARTEN
Title (English): QUALITY CONTROL CARDS

Organization Abbreviation: VDI Document #: VDI 4009 Blatt 4 Date: 1984-04-00
Organization: VDI VEREIN DEUTSCHER INGENIEURE (VDI)
Title (original language): STICHPROBENPLAENE IM RAHMEN DER ZUVERLAESSIGKEITSSICHERUNG
Title (English): SAMPLING PLANS IN RELIABILITY ASSURANCE

Organization Abbreviation: VDI Document #: VDI 4009 Blatt 5 Date: 1985-02-00
Organization: VDI VEREIN DEUTSCHER INGENIEURE (VDI)
Title (original language): WEIBULL-VERTEILUNG UND ANDERE EXTREMWERTVERTEILUNGEN
Title (English): WEIBULL-DISTRIBUTION AND OTHER EXTREME VALUE DISTRIBUTIONS

Organization Abbreviation: VDI Document #: VDI 4009 Blatt 7 Date: 1985-09-00
Organization: VDI VEREIN DEUTSCHER INGENIEURE (VDI)
Title (original language): NUMERISCHE VERFAHREN ZUR BESTIMMUNG VON VERTEILUNGSPARAMETERN IN DER ZUVERLAESSIGKEITSRECHNUNG
Title (English): NUMERICAL METHODS FOR EVALUATION OF DISTRIBUTION-PARAMETERS IN RELIABILITY

Organization Abbreviation: VDI Document #: VDI 4009 Blatt 8 Date: 1985-05-00
Organization: VDI VEREIN DEUTSCHER INGENIEURE (VDI)
Title (original language): ZUVERLAESSIGKEITSWACHSTUM BEI SYSTEMEN
Title (English): RELIABILITY GROWTH OF SYSTEMS

Organization Abbreviation: VDI Document #: VDI 4009 Blatt 9 Date: 1983-06-00
Organization: VDI VEREIN DEUTSCHER INGENIEURE (VDI)
Title (original language): METHODEN DER PUNKT- UND BEREICHSSCHAETZUNG VON ZUVERLAESSIGKEITSKENNGROESSEN UND TESTEN VON HYPOTHESEN
Title (English): METHODS OF POINT- AND INTERVAL-ESTIMATION OF RELIABILITY-PARAMETERS AND HYPOTHESIS TESTING

Organization Abbreviation: VDI Document #: VDI 4009 Blatt 10 Date: 1986-08-00
Organization: VDI VEREIN DEUTSCHER INGENIEURE (VDI)
Title (original language): ANALYTISCHE METHODEN DER FEHLERERKENNUNG ZUR ZUVERLAESSIGKEITSSICHERUNG
Title (English): ANALYTICAL METHODS FOR FAULT DETECTION IN RELIABILITY ASSURANCE

Organization Abbreviation: VDI Document #: VDI 4010 Blatt 1 Date: 1986-06-00
Organization: VDI VEREIN DEUTSCHER INGENIEURE (VDI)
Title (original language): UEBERBLICK UEBER ZUVERLAESSIGKEITS-DATEN-SYSTEME (ZDS)
Title (English): SURVEY ON RELIABILITY DATA SYSTEMS

Organization Abbreviation: VDI Document #: VDI 4010 Blatt 2 Date: 1984-03-00
Organization: VDI VEREIN DEUTSCHER INGENIEURE (VDI)
Title (original language): STRUKTUR EINES ZUVERLAESSIGKEITS-DATENSYSTEMS (ZDS)
Title (English): FUNDAMENTALS OF A RELIABILITY DATA SYSTEM

Organization Abbreviation: VDI Document #: VDI 4010 Blatt 3 Date: 1985-01-00
Organization: VDI VEREIN DEUTSCHER INGENIEURE (VDI)
Title (original language): PLANUNG EINES ZUVERLAESSIGKEITS-DATEN-SYSTEMS (ZDS)
Title (English): PLANNING OF A RELIABILITY DATA SYSTEM

Organization Abbreviation: VDI Document #: VDI 4010 Blatt 4 Date: 1984-03-00
Organization: VDI VEREIN DEUTSCHER INGENIEURE (VDI)
Title (original language): ERRICHTUNG, VERWENDUNG UND BETRIEB EINES ZUVERLAESSIGKEITS-DATENSYSTEMS
Title (English): IMPLEMENTATION AND USE OF A RELIABILITY DATA SYSTEM

APPENDIX D: SUMMARY OF DEPENDABILITY-RELATED STANDARDS SPECIFIC TO THE TELECOMMUNICATIONS INDUSTRY

Due to the increasing importance and growth of the telecommunications industry, this section is devoted to listing those standards, reference guides and handbooks dealing specifically with R, M, A & D of telecommunications equipment and systems. Note that because none of the documents were actually reviewed, some judgment has been made as to whether a document is truly an R, M, A & D document, based solely on the document's title. Information on the particular agency responsible for development and control of each document listed can be found in Appendix B.

The following standards bodies and associations are represented in the list of documents that follow.

Organization	Organization Abbreviation
International Telecommunication Union	ITU
European Telecommunication Standard Institute	ETSI
Bell Communications Research	Bellcore
Conférence Européenne des Administrations des Postes et des Télécommunications	CEPT

List of Reliability, Maintainability, Dependability Standards, Handbooks and Guidelines Written for the Telecommunication Industry

Organization Abbreviation: ITU
Organization: International Telecommunication Union
The ITU, headquartered in Geneva, Switzerland is an international organization within which governments and the private sector coordinate global telecom networks services. ITU activities include the coordination, development, regulation and standardization of telecommunications and organization of regional and world TELECOM events.

ITU-T	Recmn E.431	Service Quality Assessment for connection Set-up and release Delays
	Recmn E.432	Connection Quality
	Recmn E.800	Quality of Service and Dependability Vocabulary - Telephone Network and ISDN - Quality of service, Network Management and Traffic Engineering
	Recmn E.862	Dependability Planning of Telecommunication Networks

Recmn E.880	Field Data Collection and Evaluation on the performance of equipment, Networks and Services
Recmn M.21	Maintenance philosophy for telecommunication Services - Maintenance: Introduction and General Principles of Maintenance and Maintenance Organization
Recmn M.60	Maintenance terminology and Definitions
Recmn M.15	Maintenance consideration for new Systems
Recmn M.3602	Application of maintenance principles to ISDN subscriber installations
Recmn M.1020	Characteristics of special quality international leased circuits with special bandwidth conditioning
Recmn M.10	Scope and application of Recommendations for maintenance for telecommunication networks and services
Recmn M.1375	Maintenance of international data transmission systems
Recmn Z.400	Structure and Format of Quality Manuals for Telecommunications Software

Organization Abbreviation: ETSI
Organization: European Telecommunication Standard Institute
The youngest of the three European standards bodies, recognized by the European Council of Ministers by Council Directive 83/189, ETSI was set up in 1988 to set standards for Europe in telecommunications and, in cooperation with the European Broadcasting Union (EBU) and CEN/CENELEC respectively, the related fields of broadcasting and office information technology. ETSI was born of a recognition that a European telecommunication infrastructure with full interoperability was the only basis on which a European market for communications equipment and services could thrive. Its main task is to accelerate the process of technical harmonization.

ETS 300 404	Broadband Integrated Services Digital Network (B-ISDN); Operation and Maintenance
ETR 078	Maintenance: Telecommunication management Network TMN interface specification methodology [CCITT Recommendation M.3020]
ETR 155	Asynchronous Transfer Mode (ATM); Operation and Maintenance (AOM) functions and parameters for assessing performance parameters

ETS 300 119-1	Equipment Engineering (EE): European telecommunication standard for equipment practice Part 1: Introduction and terminology
ETS 300 386-1	Equipment Engineering (EE); Public telecommunication network equipment Electro-Magnetic Compatibility (EMC) requirement part 1: Product family overview compliance criteria and test levels
ETS 300 445	Radio Equipment and Systems (RES); Electro-Magnetic Compatibility (EMC) standard for wireless microphones and similar Radio Frequency and audio link equipment
ETS 300 446	Radio Equipment and Systems (RES); Electro-Magnetic Compatibility (EMC) standard for second generation Cordless telephone (CT2) apparatus operating in the frequency band 86 1 MHz to 868
ETR 021	Advanced Testing Methods (ATM); Tutorial on protocol conformance testing (Especially OSI standards and profiles)
ETR 025	Advanced Testing Methods (ATM); Evaluation criteria procedures for the standardization of test specifications for European function standards
ETR 039	Human Factor (HF); Human factors standards for telecommunications applications
ETR 040	Advanced Testing Methods (ATM); Profile test specifications and conformance test reports
ETR 049	Advanced Testing Methods (ATM); state of research in the area of formal test specification methods
DTR/MTS-00003	Methods for testing and Specification (MTS); Guidance on the production and completion of System Conformance Statement (SCS) performance

Organization Abbreviation: Bellcore
Organization: Bell Communications Research
Bell Labs research mission is to enhance AT&T's technological advantage in core areas, to assure the rapid transfer of technology, and to provide AT&T with early insight into emerging technologies for present and future businesses.

FA-NWT-001315	In-Process Quality Metrics(IPQM) Framework Generic Requirement

FA-NWT-001349	Reliability and Quality Measurement for Telecommunications Systems (RQMS) Supplier Support Measurements
FR-78	Physical Design for Reliability Family of Requirements
FR-357	Component Design for Reliability Family of Requirements
FR-NWT-000796	Reliability and Quality Generic Requirement (RQGR.FR-796)
GR-282-CORE	Software Reliability and Quality Acceptance Criteria (SRQAC) A model of ROGR, FR-796
GR-282-SET	Software Reliability and Quality Acceptance criteria (a module of RQGR.FR-796)
GR-512-CORE	LATA Switching Systems Generic Requirements (LSSGR): Reliability, Section 12 (a module of LSSGR, FR-64 & FR-NWT-00750)
GR-512-SET	LSSGR: Reliability, Section 12 (a module of LSSGR, FR-64 & FR-NT-00750)
GR-929	ILR Reliability and Quality Measurements for Telecommunications Systems (a module of RQGR, FR-796)
GR-1221-SET	Generic Reliability Assurance Requirements for Fiber Optic Branching Components Hygroscopic Dust
GR-1274-CORE	Generic Requirements for Reliability Qualification Testing of Printed Wiring Assemblies Exposed to Airborne Hygroscopic Dust
GR-1421-CORE	Generic Requirements for ESD - Protective Circuit Packet Containers
GR-2903-CORE	Reliability Assurance Practices for Fiber Optic Data Links
GR-2903-SET	Reliability Assurance Practices for Fiber Optic Data Links
GR-874-CORE	An Introduction to the Reliability and Quality Generic Requirement (RQGR)

GR-874-SET	An Introduction to the Reliability and Quality Generic Requirements (RQGR) (a module of ROGR, FR-796)
GR-929-CORE	Reliability and Quality Measurements for Telecommunications Systems (a module of RQGR.FR-796)
GR-929-SET	Reliability and Quality Measurements for Telecommunications Systems (RQMS) (a module of RQGR, FR-796)
GR-1202-CORE	Generic requirement for customer sensitive quality infrastructure
GR-1221-CORE	Generic Reliability Assurance Requirements for Fiber Optic Branching Components
GR-1274-CORE	Generic Requirement for Reliability Qualification Testing of Printed Wiring Assemblies Exposed to Airborne Hygroscopic Dust
GR-1274-SET	Generic Requirements for Reliability Qualification Testing of Printed Wiring Assemblies Exposed to Airborne Hygroscopic Dust
GR-1323-CORE	Supplier Data - Comprehensive Generic Requirements
GR-1421-CORE	Generic Requirements for ESD-Protective Circuit packet Containers
GR-1508-CORE	Objectives for R&Q Measurements for Telecommunications Systems (RQMS)
GR-2813-CORE	Generic Requirement for Software Reliability Prediction (a module of RQGR.FR-796)
GR-2813-SET	Generic Requirements for Software Reliability Prediction
GR-2841-CORE	Generic Requirement for Operations Systems Platform Reliability
GR-2841-SET	Generic Requirements for Operations Systems Platform Reliability
GR-2840-CORE	Generic Requirement for Environmental Stressing Applied to Telecommunications Products
GR2912-CORE	Generic Requirements for Reliability in Manufacturing

GR-2912-SET	Generic Requirement for Reliability in Manufacturing
LP-Y64 ARPP	Automated Reliability Prediction Procedure
SR-3166	Preliminary Requirements for Environmental Stressing Applied to Telecommunications Equipment
SR-3244	Reliability Concerns With Lightwave Components
SR-ARH-002855	Optical Isolators: Reliability Issues and Proposed Tests
SR-NWT-000821	Field Reliability Performance Study Handbook (a module of RQGR.FR-796)
SR-NWT-001907	Transport Reliability Analysis Generic Guidelines (TRAGG)
SR-NWT-002030	Product Reliability Technical Auditing Services
SR-STS-002349	Service Management System (SMS)/800 Availability, Reliability, and Response Time
SR-TSY-000385	Bell Communications Research Reliability Manual (a module of RQGR.FR-796)
SR-TSY-000963	Network Switching Element Outage Performance Monitoring Procedures (a module of RQGR, FR-796)
SR-TSY-001130	Reliability & System Architecture Testing (a module of RQGR, FR-796)
SR-TSY-001136	Handbook for Digital Cross-Connect System Quality and Reliability Analyses
SR-TSY-001171	Methods and Procedures for System Reliability Analysis (a module of RQGR.FR-796)
SR-TSY-001369	Introduction to Reliability of Laser Diodes and Modules (a module of RQGR.FR-796)
SR-TSY-001547	The Analysis and Use of Software Reliability and Quality Data (a module of RQGR, FR-796)
SR-TSY-001630	Component Reliability Analysis: General Findings and Trends (1989)

TR-NWT-000332	Reliability Prediction Procedure for Electronic Equipment (a module of RQGR.FR-796)
TA-NWT-000357	Generic Requirement for Assuring The Reliability Of Components Used in Telecommunication Equipment
TA-NWT-000942	Hardware Reliability Assurance Program (H-RAP) Generic Requirements for Telecommunications Products
TR-NWT-000874	An Introduction to the Reliability and Quality Generic Requirements (RQGR)
TA-NWT-000512	LSSGR Section 12: Reliability, Bulletin No. 1
TA-NWT-000929	Objective for Reliability and Quality Measurements for Telecommunications Systems (RQMS)
TA-NWT-000983	Reliability Assurance Practices for Optoelectronic Devices in Loop Applications
TA-NWT-001221	Generic Reliability Assurance Requirements for Fiber Optic Branching Components
TA-NWT-001274	Generic Requirements for Reliability Qualification Testing of Printed Wiring Assemblies Exposed to Airborne Hygroscopic Dust
TA-NWT-001312	Generic Requirements for Optical Fiber Amplifier Performance and Reliability Issues
TA-NWT-001338	Generic Requirements for Product Reliability of Transport Resource Manager
TA-NWT-001339	Generic Reliability Requirements for Digital Cross-Connect Systems
TR- NWT-000357	Generic Requirement for Assuring the Reliability of Components Used in Telecommunication Systems (a module of RQGR.FR-796)
TR-NWT-000468	Reliability Assurance Practices for Optoelectronic Devices in Central Offices Applications (a module of RQGR.FR-796)
TR-NWT-000930	Generic Requirement for Hybrid Microcircuits used in Telecommunications Equipments (a module of RQGR.FR-796)
TR-NWT-001323	SUP01 Supplier Data - Comprehensive Generic Requirement

TR-NWT-001323	Supplier Data - Comprehensive Generic Requirements
TR-NWT-001359	Supplier Data - Basic General Requirements
TR-NWT-001359-SUP01	Supplier Data - Basic Generic Requirements
TR-NWT-001338	Generic Requirements for Product Reliability of Transport Resource Managers
TR-NWT-001047-SUP01 ISDN	Switching System Reliability Objectives for Primary Rate Access, Supplement 1
TR-NWT-001047 ISDN	Switching System Reliability Objectives for Basis Access
TR-NWT-000418	Generic Reliability Assurance Requirements for Fiber Optic Transport Systems (a module of RQGR, FR-796)
TR-NWT-000284	Reliability and Quality Switching Systems Generic Requirements (ROSSGR) (a module of RQGR, FR-796)
TR-NWT-000179	Quality System Generic Requirements for Software (a module of ROGR, FR-796)
TR-TSY-000390	Supplier Data Program Survey
TR-TSY-000512	SUP01 LSSGR Section 12: Reliability, Supplement for Hardware Reliability Modeling
TR-TSY-000512	LATA Switching Systems Generic Requirements (LSSGR): Reliability, Section 12
TR-TSY-000389	Supplier Data Program Analysis (a module of RQGR, FR-796)
TR-TSY-000282	Software Reliability and Quality Acceptance Criteria (SRQAC)
TR-TSY-000983	Reliability Assurance Practices for Optelectronic Devices in Loop Applications
TR-TSY-000929	Reliability and Quality Measurements for Telecommunications Systems (RQMS)
TR-TSY-000929	Reliability and Quality Measurement for Telecommunications Systems, Revision 1

TR-TSY-000929	Reliability and Quality Measurements for Telecommunications Systems (RQMS), Bulletin 1, June 1994
TR-TSY-000929-SUP01	Reliability and Quality Measurements for Telecommunications Systems (RQMS) - Supplement - RQMS Performance Report

Organization Abbreviation: CEPT
Organization: Conférence Européenne des Administrations des Postes et des Télécommunications

T/N 45-01 E	Testing the compliance of an equipment with its Reliability, Maintainability and Availability specifications
T/SF 54 E	Quality of services categories for telecommunication services

APPENDIX E: IEC/ISO MEMBER BODY INFORMATION

As per license agreement ROMLAB/1NC/1996, information on each of the IEC and ISO member bodies has been included within this document. The information contained in this appendix was obtained from the IEC and ISO homepages on the World Wide Web (WWW). For the latest information, please visit these web sites at the WWW addresses provided in Appendix B for IEC and ISO.

IEC Member Bodies

AUSTRALIA

AUSTRALIAN NATIONAL COMMITTEE OF IEC
Standards Australia
P.O. Box 1055
AU - STRATHFIELD NSW 2135

Telephone: +61 (2) 746 47 00
Telefax: +61 (2) 746 84 50

AUSTRIA

AUSTRIAN ELECTROTECHNICAL COMMITTEE
c/o Oesterreichischer Verband
für Elektrotechnik
Eschenbachgasse 9
AT - 1010 WIEN

Telephone: +43 (1) 587 63 73
Telefax: +43 (1) 586 74 08

BELARUS

BELARUS NATIONAL COMMITTEE OF THE IEC
BELSTANDART
Starovilensky Trakt, 93
BY - 220053 MINSK

Telephone: +375 0172 37 52 13
Telefax: +375 0172 37 25 88
Telex: 2521170 shkala

BELGIUM

COMITE ELECTROTECHNIQUE BELGE
9A Av. Frans Van Kalken
Boite 2
BE - 1070 BRUXELLES

Telephone: +32 (2) 556 01 10
Telefax: +32 (2) 556 01 20

BRAZIL

BRAZILIAN NATIONAL COMMITTEE
OF THE IEC
COBEI
Rua Libero Badaro, 496 - 10° andar
BR - 01008.000 SAO PAULO - SP

Telephone: +55 (11) 239 11 55
Telefax: +55 (11) 604 01 92
Telex: 1121452 celb br

BULGARIA

BULGARIAN NATIONAL COMMITTEE OF THE IEC
COMMITTEE FOR STANDARDIZATION
AND METROLOGY
21, 6th September Street
BG - 1000 SOFIA

Telephone: +359 (2) 85 91
Telefax: +359 (2) 801 402
Telex: 22570 dks bg

CANADA

CANADIAN NATIONAL COMMITTEE OF THE IEC
Standards Council of Canada
International Standardization Division
45, O'Connor Street, Suite 1200
CA - OTTAWA, ONT. K1P 6N7

Telephone: +1 (613) 238 32 22
Telefax: +1 (613) 995 45 64
Telex: 053-4403 stancan ott
Telegrams: STANCAN, OTTAWA
E-mail: mmbourassa@scc.ca

CHINA

CHINESE NATIONAL COMMITTEE OF THE IEC
CSBTS
4 Zhichun Road
Haidian District, P.O. Box 8010

CN - BEIJING 100088

Telephone: +86 (10) 6202 2288
Telefax: +86 (10) 6203 3737
Telegrams: 1918 beijing

CROATIA

STATE OFFICE FOR STANDARDIZATION
AND METROLOGY
Ulica Grada Vukovara 78
HR - 10000 ZAGREB

Telephone: +385 1 613 34 44
Telefax: +385 1 53 66 88

CYPRUS Associate Member

IEC NATIONAL COMMITTEE OF CYPRUS
Cyprus Organization for Standards
& Control of Quality
Ministry of Commerce, Industry & Tourism
CY - 1421 NICOSIA

Telephone: +357 (2) 30 01 92
Telefax: +357 (2) 37 51 20
Telex: 2283 mincomin
Tel: +357 (2) 37 50 53

CZECH REPUBLIC

CZECH NATIONAL COMMITTEE OF THE IEC
Czech Office for Standards,
Metrology and Testing (COSMT)
Biskupsky dvùr 5
CZ - 113 47 PRAHA 1

Telephone: +42 2 232 4430/4373
Telefax: +42 2 232 4373/4560

DENMARK

DANSK STANDARD
Danish Standards Association
Kollegievej 6
DK - 2920 CHARLOTTENLUND

Telephone: +45 (39) 96 61 01
Telefax: +45 (39) 96 61 02
E-mail: dansk.standard@ds.dk

EGYPT

THE EGYPTIAN NATIONAL COMMITTEE
Ministry of Electricity & Energy
Abbassia Post Office

EG - CAIRO

Telephone: +20 (2) 83 06 41
Telefax: +20 (2) 261 65 12
Telex: 92097 power un

ESTONIA Associate Member

ESTONIAN NATIONAL COMMITTEE OF THE IEC
Estonian Electrotechnical Committee
for Standardization (EEK)
Kopli 82
EE - 0004 TALLINN

Telephone: +372 2 493 497
Telefax: +372 6 541 276

FINLAND

FINNISH ELECTROTECHNICAL STANDARDS
ASSOCIATION (SESKO)
P.O. Box 134
FI - 00211 HELSINKI

Telephone: +358 9 696 391
Telefax: +358 9 677 059
E-mail: otso.kuusisto@energia.fi
or
E-mail: tuomo.ilomaki@sesko.fi

FRANCE

COMITE ELECTROTECHNIQUE FRANCAIS
UTE (Union Technique de l'Electricité)
Immeuble Lavoisier
4, place des Vosges
FR - 92052 PARIS LA DEFENSE CEDEX

Telephone: +33 (1) 46 91 11 11
Telefax: +33 (1) 47 89 47 75

GERMANY

DEUTSCHES KOMITEE DER IEC
Deutsche Elektrotechnische
Kommission in DIN und VDE (DKE)
Stresemannallee 15
DE - 60596 FRANKFURT AM MAIN 70

Telephone: +49 (69) 630 80
Telefax: +49 (69) 96 31 52 18

GREECE

HELLENIC ORGANIZATION FOR
STANDARDIZATION (ELOT)
313, Acharnon St.
GR - 111 45 ATHENS

Telephone: +30 (1) 22 80 001
Telefax: +30 (1) 22 83 034
Telex: 219 670 elot gr

HUNGARY

HUNGARIAN NATIONAL COMMITTEE OF THE IEC
MAGYAR SZABVANYUGYI HIVATAL
Ulloi ut 25
Pf. 24
HU - 1450 BUDAPEST 9

Telephone: +36 (1) 218 30 11
Telefax: +36 (1) 218 51 25
Telex: 225723 norm h
Telegrams: NORMHUNGARIA BUDAPEST

INDIA

BUREAU OF INDIAN STANDARDS
Manak Bhavan
9, Bahadur Shah Zafar Marg
IN - NEW DELHI 110 002

Telephone: +91 (11) 323 01 31
Telefax: +91 (11) 323 40 62
Telex: 081-316 58 70 bis in
Telegrams: MANAKSANSTHA

INDONESIA

DEWAN STANDARDISASI NASIONAL - DSN
Sasana Widya Graha - LIPI 5th floor
PO Box 3123, J1n. Jend. Gatot Subroto 10
ID - JAKARTA 12710

Telephone: +62 (21) 520 6574
Telefax: +62 (21) 520 6574
Telex: 62875 pdin ia
Telegrams: LIPI - JARKARTA

IRELAND

ELECTRO-TECHNICAL COUNCIL OF IRELAND
Ballymun Road
IE - DUBLIN 9

Telephone: +353 (1) 83 76 773
Telefax: +353 (1) 83 69 821
Telex: 32501 olas ei

ISRAEL

THE STANDARDS INSTITUTION OF ISRAEL
42, Chaim Levanon Street
IL - TEL-AVIV 69977

Telephone: +972 (3) 64 65 154
Telefax: +972 (3) 64 12 762
Telex: 35508 siit il
E-mail: standard@netvision.net.il

ITALY

COMITATO ELETTROTECNICO ITALIANO
Viale Monza, 259
IT - 20126 MILANO

Telephone: +39 (2) 25 77 31
Telefax: +39 (2) 257 73 210
Telex: 312207 ceitali
Telegrams: ELETTROCOMIT MILANO
E-mail: camagni@ceiuni.it

JAPAN

JAPANESE INDUSTRIAL STANDARDS COMMITTEE
c/o International Standards Division
AIST - MITI
3-1, Kasumigaseki 1-chome, Chiyoda-ku
JP - TOKYO 100

Telephone: +81 3 3501 2096
Telefax: +81 3 3580 8637

KOREA (REPUBLIC OF)

KOREAN NATIONAL COMMITTEE OF IEC
KNITQ, 1599 Kwangyang-dong,
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